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Repair Work in a Tennessee Railroad Shop

Arc Welding—Driving Box Work—Machining Shoes and Wedges—Utilizing Old Asbestos Insulation—Inserting New Pieces in Broken Frames

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ARC WELDING both for repairing broken parts and building up worn surfaces is a great boon to the railroad shop. Some examples of work done by the electric arc at the Coster shops of the Southern Railway System, Knoxville, Tenn., are shown in Figs. 1, 2 and 3. The slipper-type crosshead, Fig. 1, was cracked along the line *A* so the metal was cut out between the lines *B* and *C* and new metal fused or welded in by the electric torch, rendering the crosshead as serviceable as if a whole new casting had been made.

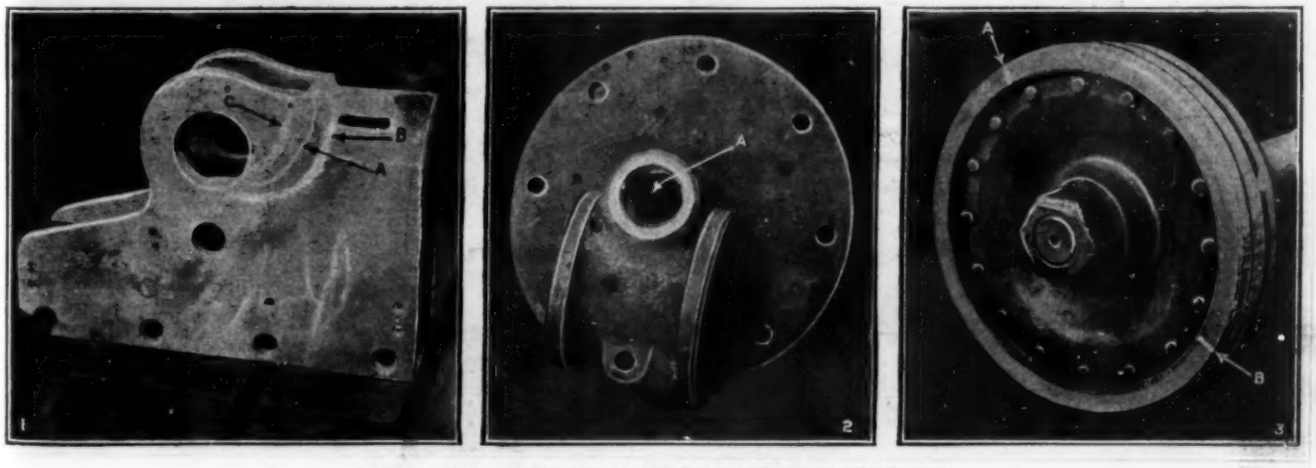
The cylinder head at the steam end of an air pump, Fig. 2, needed building up in the hole *A* and on the face of the boss to provide metal for truing while undergoing repairs. As building up with iron leaves a surface difficult to machine satisfactorily, the building up was done with brass. Another place where brass was used was on the outside of the piston shown in Fig. 3. Nearly all the wear on a piston is at the bottom where it bears on the lower part of the cylinder wall. When such wear reduces the piston so that the depth of the groove is insufficient to properly support the rings, the piston will have to be scrapped unless some method is at hand to restore metal in place of that worn away.

In the piston referred to, brass has been fused on that part of the periphery next to the first groove, and between the points *A* and *B*. The job has only been started and the other parts of the periphery between *A* and *B* will be likewise built up. After enough metal has been put on, the piston will be trued up in the lathe and the sides of the grooves faced. It has been the experience in this shop that pistons so repaired run longer between repairs than do new ones and that, as brass and iron make excellent bearing surfaces, there is less wear on the lower walls of the cylinders.

The repair of driving boxes constitutes a large item in the work of railroad shops and boxes for the heavier types of engines are so large as to tax the capacity of some of the machines used for certain parts of the work. One of the driving boxes of a Santa Fé type engine is shown undergoing the boring operation in Fig. 4. As this box carries a crown brass 22 in. long, some idea may be had of its size and the difficulty of handling it on machines installed before this type of engine was in use. It was stated above that the crown brass for this box was 22 in. long. Originally, the crown brass was that length, but the Southern System has found that brasses of such length wear bell mouthed on the ends next to the driver hubs, leaving about 14 in. for actual bearing on the axle. As the other 8 in. does no good, it was decided, when making repairs, to put in brasses only 14 in. in length, thus saving a considerable amount of costly material.

A few driving boxes of the ordinary type in the shop for repairs are shown in Fig. 5. Some must be replaned where the shoes and wedges fit, others must have new hub liners put on, and nearly all must be fitted with new crown brasses. In pressing crown brasses in or out of the boxes, the hydraulic press, Fig. 6, is used. Here all the boxes belonging to one engine are put on the truck shown in the illustration. This truck passes freely through the opening between the ram and anvil of the press, so that the boxes are brought consecutively into position by merely pushing the truck along the rails. This method of handling keeps the boxes for each engine by themselves.

Machining crown brasses to fit driving boxes may be done in several ways, such as shaping, slotting, or turning on the boring mill or lathe. Figure 7 shows the



FIGS. 1 TO 3—REPAIRS MADE BY ELECTRIC WELDING

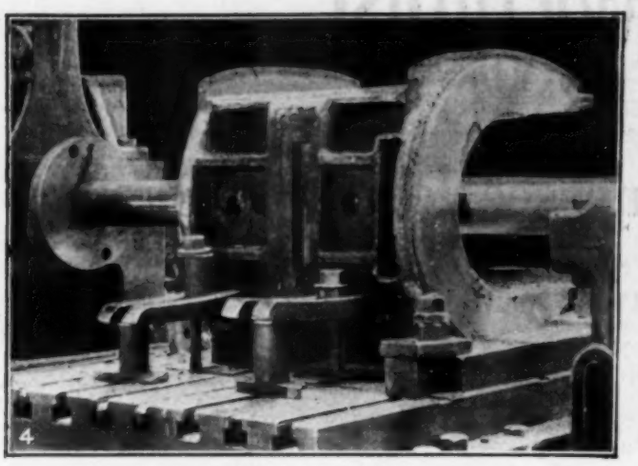


FIG. 4—BORING A SANTA FÉ DRIVING BOX

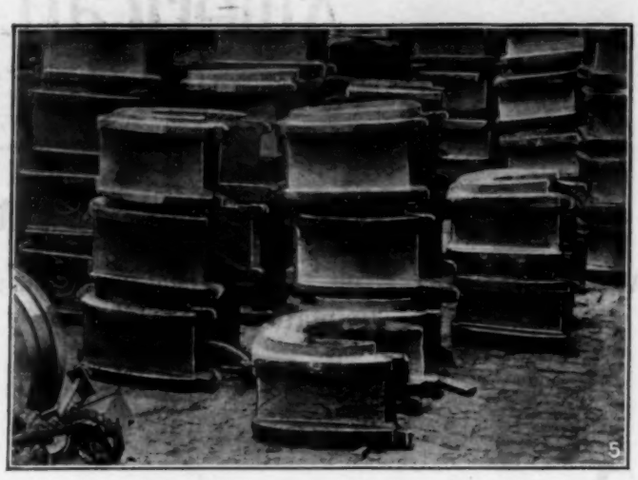


FIG. 5—DRIVING BOXES TO BE REPAIRED

operation on the lathe where the brass is mounted on a special mandrel and confined between collars at each end. Cup pointed setscrews in the collars bite into the ends of the brass and hold it securely. In planing driving boxes, they are strung out on the planer table, each box being held down by its individual pair of clamps, as shown in Fig. 8. End stops, to prevent shifting under the pressure of the cut, are, of course, set in place.

Shoes and wedges are also strung out on the planer table, shoes on one side and wedges on the other, as shown in Fig. 9. Both planer heads are in use and carry special tools, the one at *A* planing both the inside edges of the shoe simultaneously. The straddle tool for planing the outside edges, to be seen on top of the shoes at *B*, is a forging fitted with clamps for holding toolbits at *C* and *D*. To the right of the straddle tool at *E* is one of the clamps used between the ends of the shoes to hold them in place during the planing operation.

The tools and clamps described are used alike on both shoes and wedges. Shoes and wedges for engines of the Santa Fé type are generally planed singly as there

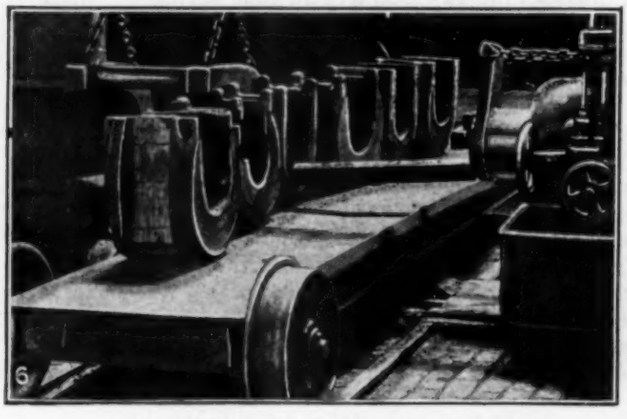


FIG. 6—PRESSING OUT CROWN BRASSES

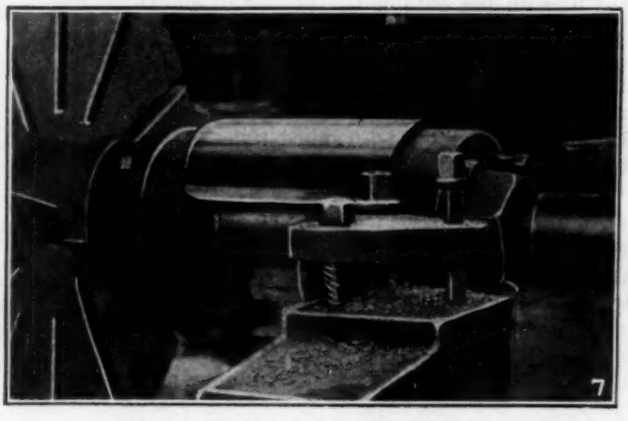
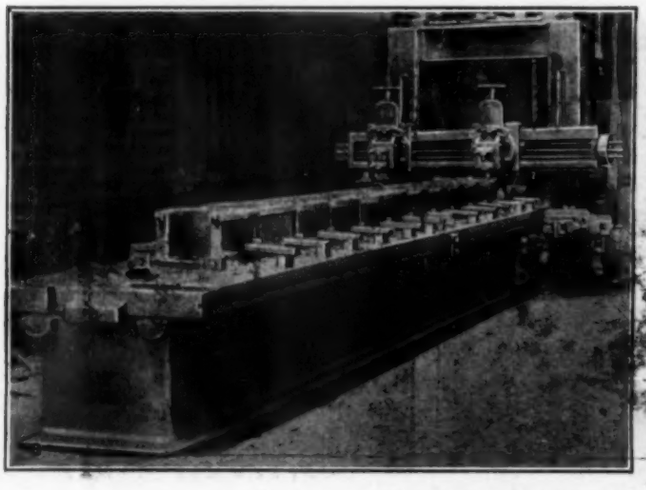


FIG. 7—TURNING A CROWN BRASS



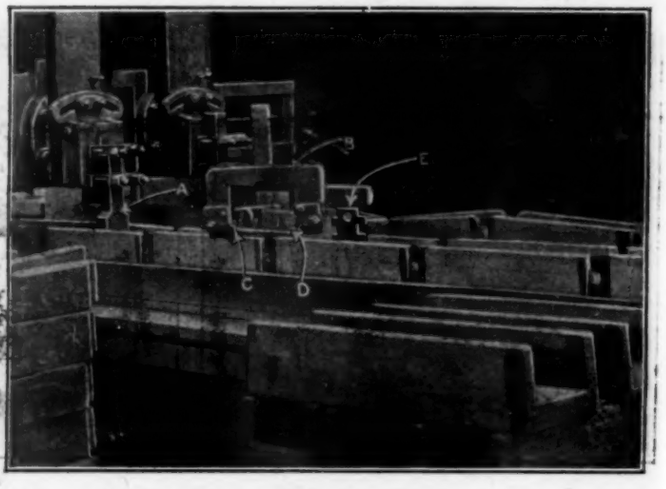


FIG. 8—PLANING DRIVING BOXES. FIG. 9—PLANING SHOES AND WEDGES

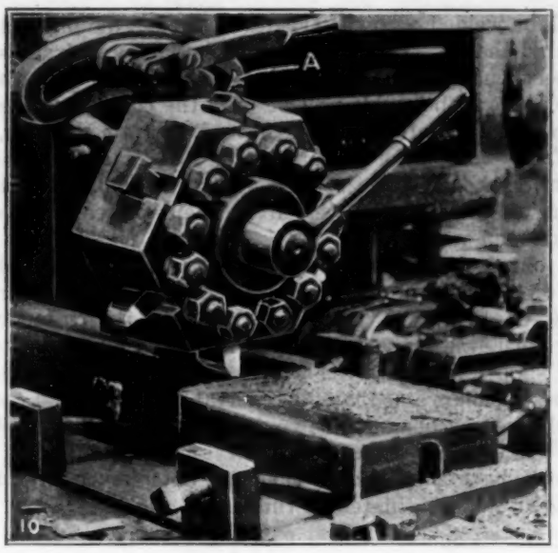


FIG. 10—TURRET MOUNTED ON PLANER HEAD.

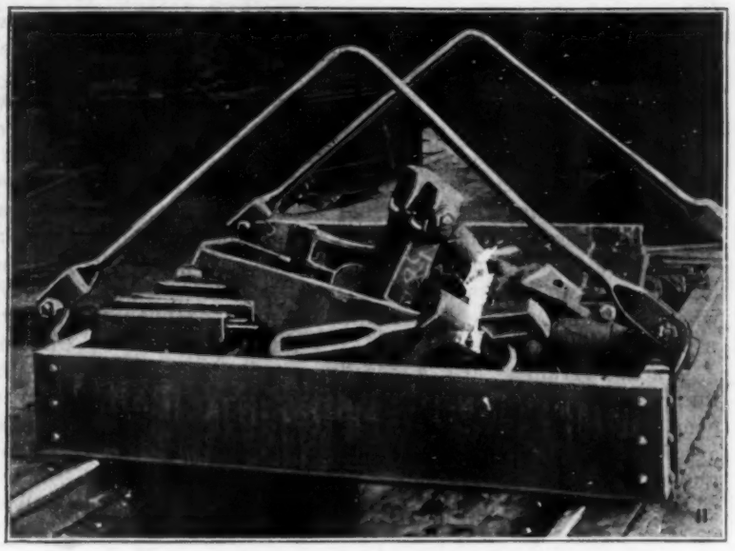


FIG. 11—BOX FOR TRANSPORTING SMALL PARTS

are not enough of them to be planed at any one time to warrant fitting up for stringing them out. Even where this is done, it would only apply to work on the outside as they are closed at one end which would prevent the inside tool from passing through. Fig. 10 shows the planing of a Santa Fé type shoe on a planer provided with a turret in which all the necessary tools are held. At the top at *A* is the combined right and left hand tool for forming the rounded corners on each side of the shoe.

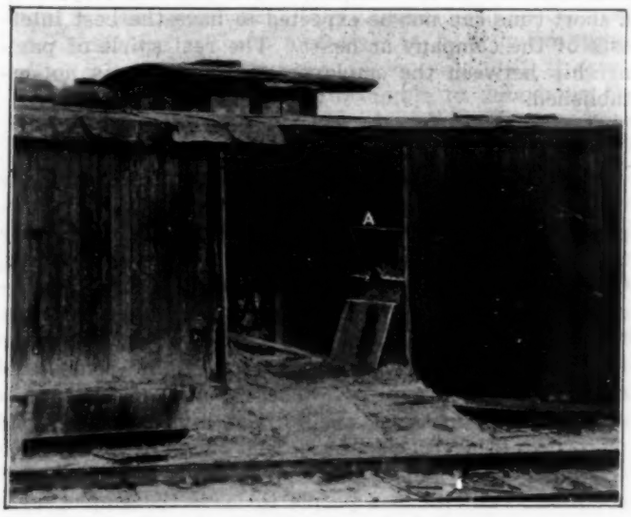


FIG. 12—MILL FOR GRINDING ASBESTOS

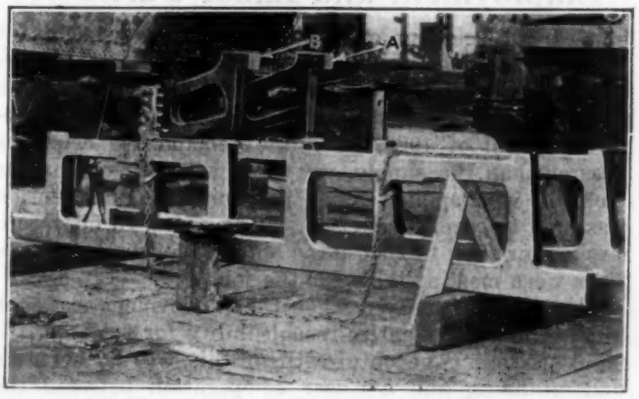


FIG. 13—NEW PARTS OF FRAMES

When locomotives are stripped for repairs, all smaller parts are put in shallow boxes or trays permanently equipped with slings so as to be readily handled by the crane. One of these boxes is shown in Fig. 11. By

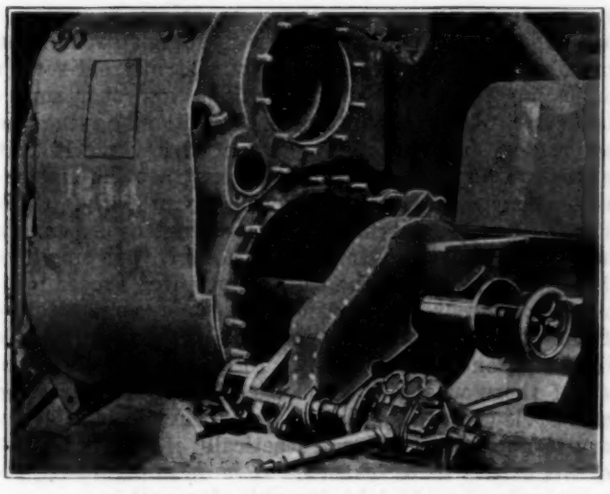


FIG. 14—RE-BORING A CYLINDER

FIG. 15—A PORTABLE BULLDOZER

this method the smaller parts of an engine can be transported to any part of the shop and kept by themselves.

In stripping the jacket from the boiler, many of the asbestos blocks or slabs used for insulation are more or less damaged so as to be unfit for use. In some shops these damaged blocks are scrapped, but here a grinding mill has been installed in an old freight car as at *A*, Fig. 12, where the blocks are ground up. The pulverized material is made into plaster and used for filling in between blocks and covering irregular surfaces when reinsulating the boiler and answers the purpose as well as new plaster.

Cracked frames are generally repaired by welding, using the thermit process. It sometimes happens, however, that frames are so badly damaged that a considerable part of one or both have to be cut out and new parts welded in place.

New parts for a pair of frames are shown in Fig. 13 and will be welded onto the frames of the engine blocked up behind them. The rear ends of the damaged frames have been cut off at *A* and *B* and, when the new parts are welded on, the welds will be over the centers of the jaw openings. Before the advent of thermit welding, these frames would have been removed and taken to the blacksmith shop where the damaged parts would be cut out and the new parts welded in their places in the old fashioned way.

The universal use of compressed air has simplified many of the repair jobs. The ease by which power can be supplied to portable tools such as the cylinder boring machine is shown in Fig. 14. The blacksmith shop too has been the gainer by the introduction of compressed air, as portable tools, such as the bulldozer or bender, shown in Fig. 15, can be used at any fire that may be convenient.

It may be mentioned in passing that the Southern valve gear was originated in this shop.

Employment and Labor Turnover

A careful selection of employees and the development of a better understanding and closer co-operation betwen the employment department and department heads are among the big employment problems of today. Before the fall of 1920, when the demand for help was greater than the supply, we welcomed with open arms anybody who applied for a position. Scant attention was paid to careful selection. It was vital to fill vacancies rather than to choose the applicant whose qualifications were most suitable for the job.

The time has arrived when the employment manager must shoulder the entire responsibility for selecting the right person. The outgrowth of this will be a better understanding and a closer co-operation between the employment department and the department heads, as well as the building up of a better personnel. Until he accepts this responsibility the employment manager can not command the confidence of the operating man on the job.

Turnover as a Health Indicator

A high labor turnover indicates an industrial disease. A very low labor turnover may similarly indicate an unhealthy condition due to failure to eliminate the unfit. Turnover is an index of the health of the company from the point of view of good employer-employee relations. Every effort is expended in time and money to obtain the good will of customers and when obtained to hold it. No organization can be successful without this policy. Why should it not be just as important, if not more so, to obtain the good will of employees? Someone has every aptly called labor turnover the "yardstick" by which we may measure the mutual understanding between employer and employee.

It is impossible to figure the cost of labor turnover except in a very general sort of way. Too many variables enter into it. Some of the costs can be figured, but it is impossible for example to determine the cost of training an employee. Some are more intelligent than others with the result that it takes less time and is therefore less expensive to train them. It is possible, however, to show an employer that turnover reduces his profits, and frequently it is easy to do so.

The importance of a group of employees who have had long service with a company can not be overestimated. No matter how well the employee is instructed in company policy, he does not really understand the policies of that company until he has learned them through experience. The employee who sticks is the real backbone of the company. The one who stays only a short time can not be expected to have the best interests of the company at heart. The real spirit of partnership between the employer and employee is not established.

Cost of Training

High turnover means high cost of training, with the result that training activities for those already employed must necessarily be curtailed on account of the time and effort expended in training new employees. Organizations which have no regular training departments may feel that they are under no training expense, but they are selling themselves a "gold brick," for there is no line of endeavor where training of some kind or other is not required. The expense of training a machinist, for instance, results from high cost of spoiled material, injured machines, and loss of time. As the purpose of all labor turnover figures is to correct conditions which cause people to leave the employ of a company, it is necessary to obtain the true reason for leaving. These, at best, are difficult to obtain. Following the line of least resistance, an employee will say that he is moving out of town, or is going to remain at home, rather than to state frankly that his real reason for leaving is bad working conditions, improper supervision, etc. Many others will leave without giving the real reason or without any notice whatever. If this happens to any great extent it means that the employment department is not functioning properly. This difficulty can be overcome to some extent by arranging that the payroll department can not give an employee his final pay without the authorization of the employment department. This plan allows some representative of the employment department to interview all people who leave, and thus cuts down to a minimum the number of those who give no cause whatever for leaving. In interviewing an employee who is leaving, it is necessary to approach him sympathetically if the real cause for his exit is to be learned. If he is antagonized, the investigator has had his trouble for nothing.

Abstract of a committee report presented at the first annual convention of the National Personnel Association, Pittsburgh, Pa., Nov. 8-10, 1922.

Industrial Cost Accounting for Executives

Third Article Deals with the Elements of Manufacturing Costs—Direct Material, Labor and Charges—Burden—Three Groups of Manufacturing Functions

By PAUL M. ATKINS

BEFORE WE can start in making records and setting up accounts, we must have some idea of what we are going to account for and record. In the case of cost accounting, that means we must have some comprehension of what the elements of manufacturing costs really are. Perhaps the reader may think to himself—Why that's easy; material, labor and overhead—everyone who knows anything at all about manufacturing records is quite familiar with that. The rub comes, however, when you try to explain just what you mean by material, labor and overhead from the cost accounting point of view. The general statement sounds easy and is fundamentally correct but, as soon as the elements are analyzed a little, certain difficulties are met with and it becomes evident that the whole question is not quite so simple as it appears at first glance.

Let us take up the various elements in order and study them a little to see what they involve. No product can be turned out without material, so it is quite appropriate to start with that cost factor. At first, it seems as though it should be quite simple to determine the cost of the material which goes into the product. If an adequate system of production control is established, no material should be issued to the factory without a written order for it. In the joobing or intermittent type of industry, written requisitions or issues should be prepared on which may be recorded the quantity of material sent out.

In the case of a continuous process plant, a standing order to issue so much of certain kinds of material each day and a notation of the quantity sent out should be sufficient record. In either case, it appears as though it should not be difficult to ascertain the cost of the "direct" material, as the material going into the product is called. So many pounds of flour, of bar steel, so many yards of sheeting, such a number of screws, bolts, castings, parts, etc., are issued for use in making the product. With the quantity known and the price fixed or findable, it should not be hard to determine the cost of direct material.

Some Materials Cannot Be Measured

It sometimes happens that there are certain practical difficulties in the way of keeping track of all the many details, difficulties which are due to the number of records which must be handled when large quantities and a wide variety of materials are issued. There are other kinds of material, however, which enter directly into the makeup of the product and yet which cannot be measured against it.

Let us take as an example the enamel which goes on the box covers of an electric switch. The enamel is certainly direct material because it forms a part of the saleable product. But how much of it actually goes on any one box cover or on any order for box covers? The engineering department or the laboratory can quite possibly tell how much *should* go on, but the cost records must show not what ought to happen but what has actually happened. The box covers are first dipped in the tank of enamel and come up dripping. They are hung over a board to catch this drip until the enamel ceases to run off and are then pushed into an oven to be baked.

It is practically impossible to measure and record the amount of this enamel against the order and so from the cost-accounting point of view it cannot be treated as direct material, although essentially that is what it is. It must, therefore, be handled in some other way. In defining direct material costs, it will be necessary to say that they are such costs of material going into and forming a part of the product as can be ascertained with a reasonable degree of accuracy at a reasonable cost.

Direct Labor That Cannot Be Charged

When we consider the matter of labor we find that a similar condition exists. In most cases it is possible to measure and record the value of the labor which is engaged directly in turning the material into the product. Whether that labor is paid by a piece rate or by some system of wage payment in which the time taken is the prime element in the measurement of the charge, is immaterial. We can measure the output or the time taken for work on a particular product or order and, knowing the rate of payment, we can calculate the direct labor cost for making the product.

On the other hand, just as in the case of material, we will find there are occasions when it is not practical to measure the time taken and so ascertain the direct labor cost. A battery of automatic lathes or screw machines is operated by one man. He goes from one to another, spends a little time adjusting one, starts some material in another, sits and looks at the whole group a few moments, doing nothing but necessarily there to take care of any need which may arise.

If all the machines are working on one order, his time might, of course, be charged to that order, but if they are working on different orders, how is his time going to be split up among them? He changes from one to another so frequently that he would spend almost as much time recording as working if he tried to allocate each moment of his time. It certainly would not pay to keep some one there to record the changes for him, and hence we find that, although he is working directly on the product, his wages cannot be treated as a direct labor cost. The expense must be handled in some other way, just as in the case of the enamel above described. Our definition of direct labor cost from the cost accounting point is that it is the cost of that labor engaged in working directly on the finished product which can be measured with reasonable accuracy at a reasonable cost.

Here we have then direct material costs and direct labor costs and are apparently ready for an investigation of what is commonly called "overhead" or "burden." Before going on to this topic, however, we must pause for a moment to consider an element of cost

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which has not yet been mentioned, which appears only infrequently, but which we cannot, nevertheless, leave out. It belongs at this point in our discussion for it is essentially one of the direct costs.

Perhaps the best way to make clear what the element is which we may call "direct charges" is to take an example. A machine shop turning out machines to order may have some part which is just too large for the equipment which it has to handle. The bed of the machine may be a bit too big to be planed on its planer and so the company sends it out to some nearby concern to have the work done for them. When the work is completed, the first company will receive a bill for it. It is evident that this bill is not for material, neither is it for labor alone, but is rather for the service rendered which is made not only of the labor but also of the cost of operating the machine on which the work was done and the profit which the second company makes on the job. At the same time from the point of view of the first company, the bill is not an element of expense, as will be obvious after the next few following paragraphs have been read, but is properly a direct charge against the order for the production of the machine on which the bed is to be used.

Hence we see that our study of the elements of manufacturing costs has revealed so far that there are ordinarily two and some times three direct costs:

(a) Direct material,
(b) Direct labor,
(c) Direct charges.

It has also shown us that the inclusive idea of direct material and direct labor needs to be modified when approached from the cost-accounting viewpoint in order to limit them to such materials and such labor as can be satisfactorily measured against the order for the product.

We are now ready to turn our attention to the question of overhead or burden as it is called by preference in these articles and try to see what it is and how it plays a part in making up the cost of the product. To my mind, burden is simply the cost of the operation of the business as a whole. A certain portion of this cost which measures the value of the services rendered by the business in the manufacture of the goods should be called earned burden and is chargeable to the orders for making the product as a proper part of the cost of production.

The other portion is a load which the business as a whole must carry and may be called "unearned burden" because it is a load which represents either excessive cost of operation or unused plant capacity or both. It is not chargeable to the product but directly to profit and loss. Space will not permit a thorough discussion of this subject here, so I must ask my readers to be patient until a later article—"Burden Earned and Unearned"—is reached. In that article the topic is vigorously investigated.

The task now before us is to see what the subelements of burden are. It has been stated that the burden was the total cost of the operation of the business, or, in other words, is the total of the expenses, which may be conveniently defined as the cost of carrying on the various departments of the business into which its functions are subdivided.

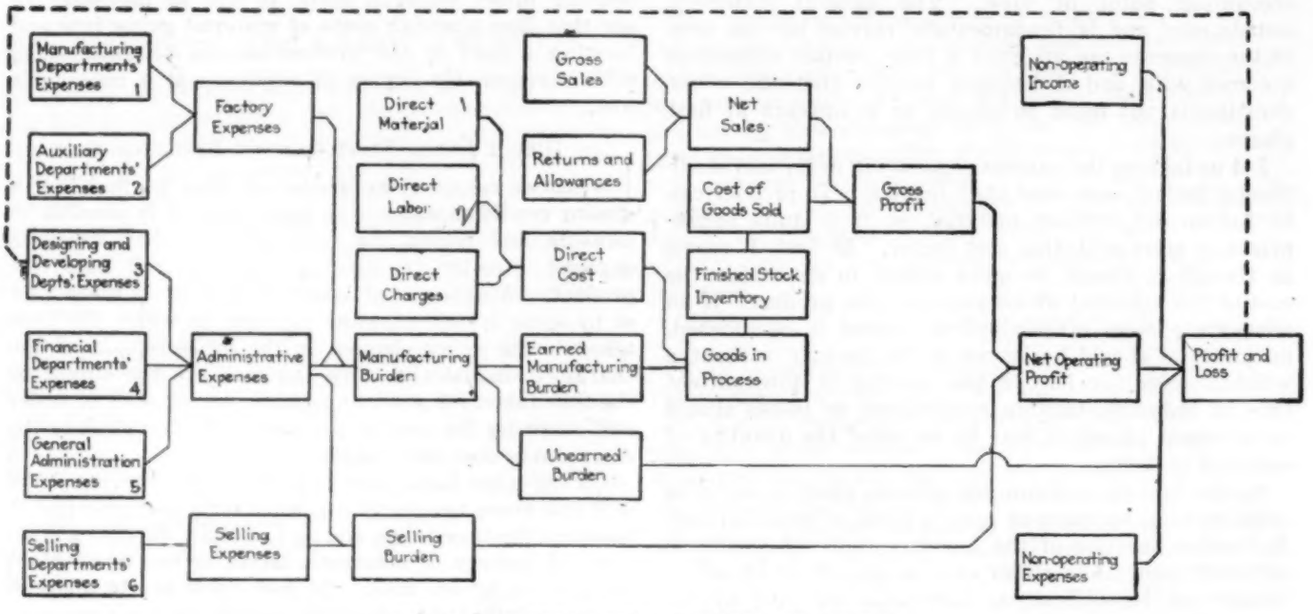


FIG. 1—A TYPICAL COST ACCOUNTING SYSTEM

The first step to be taken in studying expenses and burden, as the two phases of overhead are called, is to investigate the subdivision of the business into its functions or departments. Not more than a word or two can be said about this topic, but a later article will be devoted entirely to it. A few general suggestions, however, are necessary here. A business is nothing more nor less than a collection, sometimes a systematic, well organized collection and sometimes a heterogeneous collection of activities called functions. These are grouped into what we call departments and should be so put together as to promote harmonious cooperation in what may be termed an organization.

It is perfectly evident that the activities are going to vary greatly from industry to industry and even from company to company within an industry. Hence they cannot be discussed in detail unless a particular case is in hand. A few general points can be made, however, and these will apply to almost all manufacturing concerns no matter what their product may be.

There is hardly any manufacturing business in which the functions are not properly divided into three prin-

cipal groups. There are those which are principally concerned with the production of the finished goods; those which are occupied with selling the goods; and finally, those functions whose part is to guide, direct, supervise, and aid both selling and production. The first group may well be called the "manufacturing" functions; the second group, the "selling" functions; and the third group, the "administrative" functions.

Whether the product is steel rails or flour, cotton cloth or machinery or any other manufactured product, it must be produced, sold, and the business as a whole, administered. The three groups ordinarily should be divided in turn into departments which are the units most commonly employed as the basis for the organization and operation of the business. Of course, the number and kind of departments will vary according to the business. For our present purpose, however, it does not make any difference what they are.

Importance of Groups in Cost Accounting

It is of considerable importance that the distribution between the three groups be kept clearly in mind. The expenses of the business, it will be remembered, should be divided up according to the various departments for whose benefit they are incurred. Hence they will fall quite naturally under the three headings given above. It should be perfectly clear that all of the manufacturing expenses go to help make up the manufacturing burden but that none of them form any part of the cost of selling.

In the same way, the selling expenses are in no sense a part of the manufacturing burden but help only to make up the cost of selling. The expenses of administration are properly divided between the two since the administrative departments exist expressly for the benefit of the two other groups of functions.

Theoretically, then, the total burden of the business is divided into two parts, one of which represents the cost of operations involved in making the goods and the other, the cost of selling them. The manufacturing burden, as was pointed out, is properly divided into earned and unearned burden. Practically, there are certain difficulties involved in applying these theories to actual cases, though it is surprising how closely the theory can be followed in practice if correct methods are used. All such details as are commonly called 'indirect" or "non-productive" material, labor and expense are all included under the head of expenses together with insurance, depreciation and such items.

Elements of Manufacturing Costs

The elements which go to make up the cost of producing any goods are therefore:

(A) Direct costs
  1. Direct material
  2. Direct labor
  3. Direct charges

(B) Burden (Earned)
  1. Depreciation and other fixed charges
  2. Indirect labor
  3. Indirect material
  4. Other expenses

From this point on the course of the costs should be easily grasped from a study of the accompanying charts which show how the cost system interlocks with the general accounting system to form one comprehensive and consistent set of accounts and records. In the next article will be given a summary of the various accounts and journals which are necessary for a satisfactory recording of the various cost elements.

Explanation of Figure 1

Definition.—Expense consists of the expenditures necessary for the operation and maintenance of the various departments and includes such charges as taxes, insurance, depreciation and maintenance of all property occupied or used by the departments and a fair share of such charges for property used by several or all in common, wages and salaries of those whose time cannot be readily allocated to some production or improvement order; material used in the operation of the department, such as stationery, oil, waste, coal, etc.; outside services such as telephone, telegraph, water rates, etc.—in short, all expenditures incurred by the several departments which are needed to enable them to give the service they are expected to render. The kinds of expenses involved vary according to the departments.

1. *Manufacturing Department's Expense.* Made up of the expense incurred directly in the operation of the departments engaged directly in the manufacture of the product by changing the form or condition of the raw material.

2. *Auxiliary Department's Expense.* Made up of the expense of such departments as Purchasing, Cost, Manufacturing Standards, Finished Stock and Shipping, Heat, Light, Power, Inspection, Tool Cribs, Maintenance, Planning, Receiving, Stores, Safety and Sanitation, Training, Tool Manufacturing, Internal Transportation, Watchman and Pattern — departments whose services are rendered directly and primarily to the manufacturing departments and only incidentally to any others.

3. *Designing and Developing Department's Expense.* Made up of the expense of such departments as Blue Print and Photographs, Chemical Laboratory, Drafting, Engineering, Filing (Blue Prints and Drawings), Physical Laboratory, Experimental—departments whose chief service is that of designing and developing new products.

4. *Financial Department's Expense.* Made up of the expense of such departments as Accounting, Billing, Credits and Collections, Insurance (Property), Paymaster and Cashier—departments whose chief service is the handling and recording of financial transactions.

5. *General Administration Department's Expense.* Made up of the expense of such departments as Executive, Filing (General Office), Legal, Stenographic, Traffic—departments whose services are rendered to the business as a whole rather than to any one particular section of it.

6. *Selling Department's Expense.* Made up of the expense of such departments as Publicity, Sales, Branch Offices, Customers' Service—departments whose services consist of selling the goods of the concern and of keeping them sold.

Repairing an Engine Under Difficulties

By Hiram Hicks

Some years ago the writer was called upon to make repairs on a steam engine that furnished power for a small manufacturing establishment in a remote village.

The engine had been built by one of the old-time "backwoods" machinists from ideas and patterns of his own, and was like nothing else that ever existed. It was of the vertical type with the crankshaft at the apex of a pair of A-frames; it had two cylinders connected in the usual way to crank disks at opposite ends of the shaft, and it developed probably from 15 to 20 horsepower. The two sides of the engine were quite independent and either was capable of keeping the shop wheels turning if care was taken to regulate the power requirements to avoid "peak" loads.

There was nothing the matter with the engine except general debility; having been worn by long continued service until it was blowing away more steam than it used and making more noise than a freight train. The machine shop where it was built had long been out of business and no other was available. The shop must not be closed and there was no other power.

The only machine-tool equipment was an engine lathe of about 18-in. swing, built by the same machinist that had built the engine, and located in the attic of the shop. There was plenty of junk—the accumulated odds and ends of thirty years—from which to draw raw material, and I was fortunate enough to find in the pile all that was necessary to "make" new parts for all that had to be replaced except the pin brasses, castings for which I obtained by express from a far-away city brass foundry.

Having everything in readiness at 12 o'clock one day, one side of the engine was disconnected, the crank disk drawn off, steam and exhaust outlets plugged and a pair of improvised half-boxes fitted to that end of the shaft—all in the short space of one hour. At 1 o'clock the remaining side was started up, and it clattered gaily away for nearly two weeks while its mate was being rebuilt.

Reboring the cylinder was the first job. The casting was blocked up on the carriage of the lathe from which the cross-slide had been temporarily removed, a boring bar was placed on centers, the cylinder lined up by tramming, and two cuts were run through the bore. This was a good afternoon's work.

How the Lathe Was Rigged

Without disturbing the setting of the job the compound slide of the lathe was bolted to an angle plate that had previously been prepared to be bolted to the back of the lathe bed, and the lathe had become a shaper with a vertical slide but no cross adjustment. A splining tool of the kind commonly used for cutting keyways in the bores of wheels, gears, etc., adapted itself very nicely to the job of resurfacing the valve seat. No change was necessary in this tool except in the manner of using it; the "top rake" had become the "clearance" and the "clearance" the "top rake."

The traversing movement, equivalent to the movement of a shaper ram, was supplied by running the lathe carriage back and forth along the shears by means of the handwheel, elbow grease being the fuel consumed to supply the power. As the "shaper" had no cross movement (the casting being still bolted to the wings of the carriage) tool adjustment for successive cuts was made by putting sheet metal shims of the required thickness under the tool.

The next shaper job was the replaning of the crosshead guides. These, fortunately, were separate pieces bolted to the face of the A-frames and, being of generous proportions, needed little more than resurfacing. The crosshead was fitted with bronze shoes so that the amount of material removed from the guide (and also from the shoe) was compensated for by putting sheet metal shims of the proper thickness between the shoes and the crosshead.

The making of new pistons from chunks of iron several sizes too large, of piston rings, rods, wristpins and crankpins, etc., as well as the making of new eccentrics and reboring the straps to fit, was ordinary lathe work. The machining of the new pin brasses was, however, beyond the limitations of my "shaper" and the lathe had to become a milling machine. Several milling cutters were accordingly made, with tapered shanks to fit the spindle hole, and fluted by laying a suitable cutting tool on its side in the toolpost and again applying hand power to traverse the carriage back and forth.

To space the teeth somewhere near evenly a locking pin was rigged up to enter the tooth spaces of the main spindle gear. (I would not advise the use of this sort of a plate for accurate indexing.)

A milling machine requires movement in three planes (so, also, does a shaper for that matter) besides the rotative one of the cutter, and here the old backwoods machinist had unwittingly come to my aid when he built that lathe, for he had supplied an extra toolblock to go in place of the compound slide that could be adjusted vertically. By tapping two entirely unpremeditated holes in the front of that toolblock and making a small angle plate I was able to mount the brasses below the cutter in position to take advantage of all three adjustments.

Milling the channels in those brasses to fit the connecting-rod straps was child's play compared to the labor of getting ready to do it. With the milled brasses fitted to the straps and secured with the regular keys and a dummy rod end, the lathe once more became a lathe for the boring and facing operations.

One piece that puzzled me for quite a while was the valve, a plain D-slide, the surface of which constituted by far the largest part of it. It was so small and of such peculiar shape, besides having no place to get a strap on it without covering the surface to be machined, that I could not invent a way to hold it. I finally compromised by filing it flat and scraping it to match the valve seat on the cylinder casting.

The crankshaft ran in babbitt-filled bearings the bronze shells of which showed no wear as there was nothing in frictional contact with them. The main journals also showed so little wear when they were examined at the time of taking down the engine that it was not considered necessary to do anything to them, especially as any work upon the shaft would put the engine out of service. New babbitt in the shells put the main bearings in shape to go back.

Again at 12 o'clock, with every part tested to make sure that all would go together without delay, the engine was stopped and the new parts assembled. The opposite side was disconnected at crank and eccentric and the crosshead blocked against movement, but no part was dismounted as we wanted to make sure that the new engine was going to run. Upon starting at 1 o'clock no trouble was experienced by anybody but the engineer, who was depressed by the absence of noise, a depression no doubt eradicated by time.

Repairing the Second Engine

The new engine ran quietly and steadily all that afternoon and all the next morning until, at noon, the other side was dismounted to receive the same course of treatment. With all the special tools ready, many of the new parts nearly done (for when I had to make a new part for the first engine I had roughed out a duplicate for the other one) and with the advantage gained by the experience in knowing just what I was going to do, the second engine was put in shape in a few days. Not one minute of running time was lost by the shop and except for the three noon hours there was no overtime work done.

I saw that little engine last summer. It was clattering away as noisily and blowing away steam as recklessly as before I made that repair, but except for minor adjustments there had been no work expended upon it since that far-off March in 1897 when the engineer blamed me for "spoiling" his engine because "he couldn't tell whether it was running or not without looking at it."

The Law of the Involute Curve

Principles Developed in Preceding Article Applied to Generating Gear Teeth—Adapting the Milling Machine to Cutting Gear Teeth with the True Involute

By O. G. SIMMONS
Vice-President and General Manager,
Simmons Method-Hob Company

FROM THE theory of the involute curve developed in the preceding installment published on page 801 of *American Machinist*, it is apparent that involute curves may be generated in a lathe or a milling machine. In the case of the lathe, a piece of cardboard or metal plate is attached to the faceplate and a scriber or cutting point is placed in the toolpost so that the point is high enough above the center to coincide with the tangent line in our proposition of Fig. 1 in the preceding article. The proper change gears are placed in position to give the required lead to the cutting point. If the faceplate is rotated, the cutting point will generate an involute curve, which we now see is identical with the method which Fig. 1 demonstrates.

If, instead of a cutting point, we were to substitute an end mill, we could generate a right- and a left-hand involute curve and also the clearance space between these curves by one pass of the end mill across the blank being operated upon. Evidently, these curves can be generated according to the proposition illustrated in the previous article in Fig. 2, where two points could be used, one to generate the curve of one hand on approaching the blank, and the other the curve of the other hand on leaving the blank.

It is evident also, that the principle of Fig. 3, in the previous article could be used as that underlying the generation of involute curves, with the use of an end mill or a reciprocating planer tool as the cutter in a milling machine. This method is illustrated in Fig. 4 in which are clearly shown the end mill and the gear being operated upon, as well as the change gears necessary to obtain the lead of the involute curve. The position of the end mill can also be seen. The end mill rotates about a vertical axis, while the gear blank being operated upon has not only its rotary movement, but also a lineal movement, which is identical with the method Fig. 3 describes.

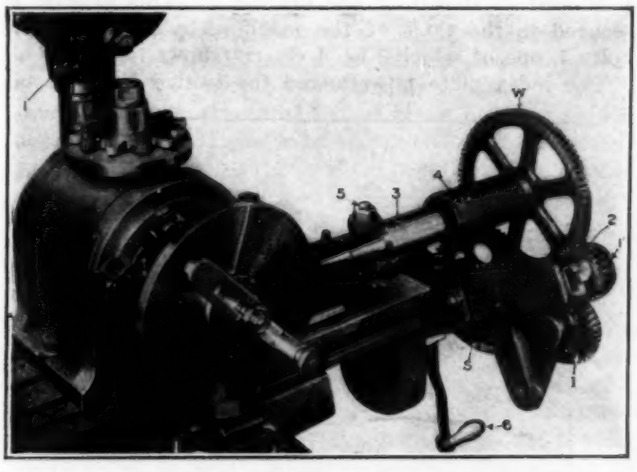


FIG. 4—MILLING MACHINE ADAPTED TO CUTTING AN INVOLUTE CURVE ON GEAR TEETH

Instead of a single marking point, however, which was shown in Fig. 3, we have an end mill provided with a series of cutting points rotating about a fixed axis. The fixed axis, of course, is the axis of the spindle of the vertical milling attachment indicated by the numeral *1* in Fig. 4. The end mill and the involute curves of the gear teeth are also visible. The axis of the gear shown is parallel to the axis of the spindle of the vertical milling attachment. This is accomplished by simply setting the spindle of the index head in a vertical position, by means of the degree graduations provided on all index heads.

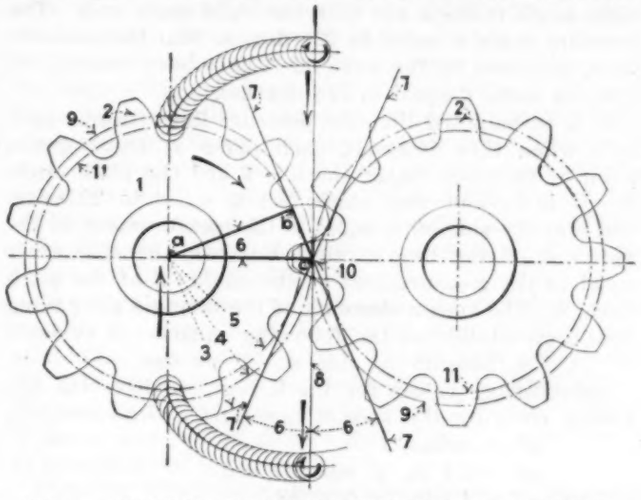


FIG. 5—DIAGRAM OF GEARS SHOWING BASE CIRCLE AND PRESSURE ANGLE

The writer believes that we should not leave this subject until the generation of the involute curve by mechanical means in an actual machine is described, as such a matter will, undoubtedly, result in a clear and precise understanding of the curve and its underlying law. Let us take, therefore, one concrete embodiment of the idea, as illustrated in Fig. 4, and generate the involute curves on the teeth of the gear shown.

Let us assume the gear is to have 12 teeth, 2.5 diametral pitch and a pressure angle of 22½ deg. Such a gear is illustrated in Fig. 5 in which the numeral *1* indicates the gear provided with the teeth *2*. The numeral *3* indicates the radius of the circle which forms the periphery of the gear, while the numeral *4* indicates the radius of the pitch circle, and the numeral *5* the radius of the base circle.

The base circle of the gear *1*, Fig. 5, is the evolute of the involute curves forming the faces of the teeth *2*. In order to determine the lead of the involute curve forming these faces, it will first be necessary to determine the diameter of the base circle. This measure of the diameter of the base circle is easily determined from the pitch circle diameter and the angle of pressure, both of which are known or determined from the data given

previously. The pitch circle diameter is found by dividing the number of teeth in the gear by the diametral pitch, giving the formula:

$$D = \frac{N}{P}$$

D = pitch circle diameter
P = diametral pitch
N = number of teeth

Substituting the values for the letters, we have:

$$D = \frac{12}{2.5} = 4.8 \text{ in.}$$

Thus, the diameter of the pitch circle is found to equal 4.8 in., and the measurement of the radius *4* of the pitch circle will equal 2.4 in. Having established this measurement, the measurement of the radius *5* of the base circle is easily determined by means of the right angle triangle *abc* with the right angle at *b*. The pressure angle is equal to 22½ deg. so that the pressure lines, indicated by the numeral *7*, have been constructed with an angle *6* equal to 22½ degrees.

It is to be noted that the pressure lines become such only when they intersect each other at the common point of tangency *10*, of the line *8* and the pitch circle *9*. It is evident that angle *bac* is equal to 22½ deg. and that the side *ab* is equal to the measurement of the radius *5* of the base circle. Further, the side *ac* is equal to the measurement of the radius *4* of the pitch circle *9*. The known elements of the triangle *abc* having thus been established the following equation is evident:

$$\text{Side } ab = \text{side } ac \times \cos bac$$

Substituting values for the letters, we have the following covering the special case under consideration:

ab = radius *5*
ab = 2.4 in. × cos 22½ deg.
Radius *5* = 2.4 in. × 0.92388
Radius *5* = 2.217312 in.

From these formulas, the diameter of the base circle which is the evolute being considered, equals twice the measurement of the radius *5*, or 4.434624 inches.

Direct Method of Finding Involute Lead

The foregoing details have been given in the interest of simplicity and to make clear all the steps covered in arriving at the measurement of the diameter of the base circle. A more direct and general method to arrive at this measurement now presents itself. Advantage is taken of the two given factors controlling the diameters of all base circles. As the pitch circle diameter is always known or quickly ascertained, and the pressure angle is always known, no further information is necessary. The diameter of any evolute or base circle may be expressed as follows:

$D'' = D \cos \alpha$
D'' = diameter of evolute
D = diameter of pitch circle
α = pressure angle

According to the law of the involute, stated in the previous article, the lead of any involute curve is equal to the perimeter of the evolute. Now our evolute is the base circle which we have under consideration, and its diameter equals 4.434624 in. To obtain the perimeter measurement, we have only to multiply the diameter measurement by 3.1415926535 which results in a lead of 13.9317821794347840 in. for the involute.

Ordinarily, the constant 3.1416 is close enough for machine construction purposes. It is usually found necessary to drop some of the decimals as we shall find in our present case. We may write our involute lead as equal to 13.9317 in. which will still be away inside any accuracy required or possible with the commercial manufacturing machines at our disposal.

It now becomes necessary for us to determine the change gears to produce the desired lead as just determined. The methods and rules for determining such change gears are given in several publications on milling machine practice and in many handbooks. These may be referred to by the reader, who, without doubt, is already thoroughly familiar with the subject. We have, therefore, only to look up the chart furnished with milling machines and, under the table of "leads," we find that the nearest lead to the one we desire is 13.933. This lead is near enough as it gives an error of only 0.0013 in. in over 13 in. The change gears to produce this lead, taken from the table, are:—

Driven	86 × 56
Driver	48 × 72

We now place these gears as indicated: The 86 gear on the worm indicated by the letter *W* in Fig. 4; the 56 gear on the stud indicated by the numeral *2*; the 48 gear on the stud indicated by the numeral *1'*; and the 72 gear on the screw which the letter *S* indicates.

We must now determine whether or not the rotary movement of the index head and the linear movement of the table are according to the proposition of Fig. 3 in the previous article. The evolute, we know, must roll on the line tangent to it. As becomes evident upon inspection, an idler gear must be introduced into our train of gears to give us the relative movements desired. We, therefore, place the idler gear, indicated by the letter *I* in Fig. 4, in our train of gears so that it engages the gears indicated by letter *S* and numeral *2*.

Milling machines have not been designed for these methods of generating involute curves. It is necessary, therefore, in order to generate right- and left-hand involute curves with a single pass across the end mill, to introduce an extension shaft secured to the worm shaft of the dividing head and to journal the extension shaft in a bracket secured to the table. The shaft referred to is indicated by the numeral *3* and is journaled as shown, in the bracket *4*. This bracket is secured to the table of the machine by means of the bolts *5*, one of which Fig. 4 clearly shows.

The index plate is arranged for twelve divisions, as

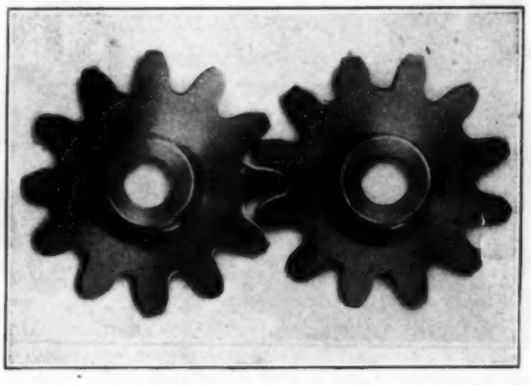


FIG. 6—PAIR OF PINIONS CUT ON A MILLING MACHINE

twelve is the number of teeth in our gear. We are now ready to generate involute curves according to the method illustrated in Fig. 3 of the previous article, using the mechanical means just described.

With reference to Fig. 5, it is noted that our evolute

or base circle is imaginary only, although it is represented by means of the circle *11*, and is well within the diameter of the blank which has the radius *3*. Mechanics will understand generally that the material to be removed between the teeth will require several cuts. Let us assume that the depth of the tooth, in order to have the center of the end mill coincide with the line tangent to the evolute at the proper depth, will equal 0.7885 inches. The center of the end mill may be well inside the tangent line without materially affecting the involute curve being generated or the thickness of the teeth of the gear.

Having decided the depth of the tooth, we can see that by removing 0.110 in. we can make seven cuts and a final cut of 0.0185 in. to finish the gear complete, or eight cuts in all. A left-hand two-lipped slotting end mill, of the high speed steel type, will accomplish nicely the first seven cuts, and a left-hand spiral end mill, shown in Fig. 4, will complete the last or finishing cut.

How Material Between Gear Teeth Is Removed

Proceeding on this theory we move in the table until the mill just touches the blank. To accomplish this, it is necessary to move the table longitudinally by means of the crank handle *6*, in Fig. 4. This will cause the blank to roll past the end mill. When the mill just touches, the graduated dial on the transverse screw should be set at the zero mark. If a left-hand end mill is used, the blank should be moved to the right of the mill to clear the mill, and the table should be moved in the 0.110 in. for the first cut. The feed is then thrown in so that the table moves to the left rolling the blank over the left-hand end mill.

When the mill leaves the blank, the machine should be stopped and the blank should be returned to its original position to the right of the mill and then indexed. The machine should be started and the cut taken for the second tooth, and so on until the first cut on all teeth has been completed, whereupon the table is moved in for the second cut and the cycle repeated until the gear is finished.

It is now obvious that we have, by positive mechanical means, generated true involute curves, the truth of which are dependent only upon the accuracy of the apparatus used. In other words, the inaccuracies of our apparatus are unquestionably reflected in the involute curves generated in the blank but to a smaller degree. A pair of twelve tooth pinions cut as previously described is shown in Fig. 6. The involute curves are clearly distinguishable as well as the circular curve lying below the base circle, which the line drawing of Fig. 5 shows.

Method Practical for Large Gears

The foregoing method is not a commercial possibility on the ordinary run of gears. It is practical, however, for large gears where the cutter cost becomes a factor. This method is used in the plant of the Simmons Method-Hob Co. to generate the curves on circular gear cutters by means of metal cutting tools before the cutters are hardened, and by means of abrasion or grinding after hardening. In this latter event, a disk emery wheel is substituted for the end mill.

We know now what an involute curve is and we are able to define it. We know the law underlying all involute curves and we can generate such a curve by a positive mechanical means admitting only of infinitesimal mechanical errors in which the human equation does not enter. We are now able to refer to an involute curve in terms of its lead. When one says an involute curve has a lead of 15 in., what is meant is immediately pictured in our minds just as though one were to say a circle is 15 in. in diameter.

A circle is referred to in terms of its diameter. We can, therefore, refer to an involute curve in terms of its lead and have an equal and complete understanding of what is meant. Many things are thus immediately given light, so that we are now prepared to apply this curve intelligently to the teeth of gear wheels.

Brief Reports Save Time

By Frank V. Faulhaber

In making out reports in the machine shop some foremen become vexed because of the extra time involved in the work. On close study it has been found that in some plants the reports that are sent in are entirely too long. Some foremen will take longer to get over their reports and this naturally points to another inefficient system. Too, when foremen are irked because of this problem, they naturally will cut themselves away from the pencil wherever possible and this means they will not take notes for their own benefit. They will thus neglect many important memorandums, such as the requirement of new stocks, etc.

In one progressive plant the superintendent has passed around the advice that reports be made brief as possible, thus to economize time. This executive observed: "It is laughable when you read some of the reports sent. We require reports from our assistant foremen, too, and it seems some of the fellows make large reports simply to have something to send in.

"On the other hand there are executives who will undervalue the importance of these reports. We find it necessary to remind them that they should send in all possible reports that in any way will help us in getting out better work, more of it, and to enable us to keep accurate tab on results. By educating each of our executives on sending in regular reports, brief, yet not overlooking anything important, we are getting more cooperation from them. A few hints have helped us materially in getting terse reports, thus saving time of the one who writes them and those who read them."

Firing Without Sufficient Cause

By A. W. Forbes

I have noted a number of articles in your paper in which it is stated that men are fired from industries with but little cause. And now the leading editorial states that it is still quite common to fire a man because "There is temporarily something wrong with his headstock."

I wonder if this can be true. Of course most persons that are fired have a long record of unsatisfactory work which culminates in a single act, and they often think that it is the single act for which they were fired. But did you ever know of a case where you knew the side of the management where anyone was fired for anything of a temporary nature? I have known of one such case. In a neighboring shop a new man set the building on fire through carelessness before he had been working long enough for the management to find out whether he was a good man or not. They did not keep him long enough to see. This is the only case I have known of.

Germany—Exports and Imports of Metal Working Machinery—("Maschinen zur Bearbeitung von Metallen")

TABLES V AND VI

Exports — Country	1909 Quantity 100 Kgs.	1909 Value 1000 Marks	1910 Quantity 100 Kgs.	1910 Value 1000 Marks	1911 Quantity 100 Kgs	1911 Value 1000 Marks	1912 Quantity 100 Kgs.	1912 Value 1000 Marks	1913 Quantity 100 Kgs.	1913 Value 1000 Marks
Belgium	28,040	3,344	39,832	4,532	41,209	4,149	39,926	4,063	66,715	6,600
Bulgaria	1,606	304	1,701	344	2,402	245	2,348	247	856	104
Denmark	6,880	1,132	6,903	1,194	7,496	726	8,477	874	10,707	1,062
France	51,491	5,497	68,794	8,062	82,575	8,356	91,945	10,036	119,065	12,726
Greece	472	78	489	72	350	39	672	79	736	83
Great Britain	12,435	1,716	23,805	2,744	19,623	2,630	26,162	3,857	55,157	5,900
Italy	63 352	8,324	62,754	8,825	101,580	7,570	58,893	6,159	57,325	5,906
Netherlands	13,650	1,955	16,286	2,370	19,028	1,953	19,357	2,118	36,412	3,582
Norway	3,736	592	3,932	629	6,275	663	8,617	909	7,163	862
Austria-Hungary	71,700	10,294	85,510	11,415	97,648	10,461	107,631	11,689	113,089	12,440
Portugal	1,360	221	1,366	218	1,722	252	1,511	254	2,290	322
Roumania	3,289	487	3,603	566	6,253	577	8,293	831	5,324	561
European Russia	30,916	4,767	42,238	6,779	65,500	7,871	81,624	8,975	130,770	15,496
Asiatic Russia	354	63	527	116	876	89	.....	.....	.....	.....
Finland	3,040	597	2,904	477	2,562	275	2,708	325	3,203	356
Sweden	9,134	1,474	8,684	1,348	10,321	1,127	12,402	1,500	17,170	2,095
Switzerland	23,916	3,641	23,684	3,678	26,869	3,096	25,612	3,246	25,905	3,062
Serbia	516	74	800	142	790	74	614	76	259	30
Spain	6,752	952	5,083	780	6,883	775	9,789	1,225	15,060	1,825
Turkey in Europe	621	122	609	110	2,866	343	3,344	417	1,392	168
Turkey in Asia	222	40	530	89	485	48	.....	.....	.....	.....
Egypt	503	78	180	39	586	60	310	39	799	70
British South Africa	405	43	662	86	253	32	449	54	360	49
German Southwest Africa	443	48	900	120	646	61	507	57	590	64
German East Africa	.....	.....	.....	.....	.....	.....	940	106	823	93
Tunis	.....	.....	.....	.....	.....	.....	58	8	501	58
British India	434	79	4,534	407	1,132	122	567	74	1,308	136
China	1,298	153	2,397	241	2,704	423	650	95	2,257	240
Japan	1,104	173	2,455	283	4,286	518	7,657	959	13,536	1,106
Dutch East Indies	1,597	218	1,810	272	2,279	241	3,028	328	4,237	485
Siam	1,446	120	303	48	95	15	.....	.....	.....	.....
Argentina	9,937	1,616	12,249	2,000	16,245	1,835	15,235	1,777	14,465	1,672
Brazil	3,448	599	5,233	834	5,473	624	10,718	1,480	12,776	1,719
Canada	207	23	350	43	715	86	626	82	785	91
Chile	1,177	230	1,160	215	1,634	212	3,286	342	2,819	329
Mexico	566	96	625	93	576	67	466	83	523	84
Uruguay	488	120	1,264	224	1,394	151	1,408	177	1,194	135
United States of America	6,501	720	8,729	1,091	6,662	944	9,819	1,171	12,591	1,709
Australia	629	98	1,364	164	1,992	263	2,368	276	2,042	244
Total	365,102	50,320	447,037	60,991	553,153	57,271	570,808	64,306	743,358	81,837

Note.—No statistics are available for the period 1914 to 1919 inclusive. Returns for 1920 and 1921 do not show this classification in the figures showing exports.

Imports — Country	1909 Quantity 100 Kgs.	1909 Value 1000 Marks	1910 Quantity 100 Kgs.	1910 Value 1000 Marks	1911 Quantity 100 Kgs.	1911 Value 1000 Marks	1912 Quantity 100 Kgs.	1912 Value 1000 Marks	1913 Quantity 100 Kgs.	1913 Value 1000 Marks	1920 Quantity 100 Kgs.	1920 Value 1000 Marks	*** 1921 Quantity 100 Kgs.	*** 1921 Value 1000 Marks
Belgium	1,759	214	1,134	156	2,044	260	2,588	323	2,356	340	.....	.....	.....	.....
Denmark	651	61	422	47	332	38	483	58	391	49	.....	.....	.....	.....
France	1,768	292	1,561	218	2,722	383	3,034	486	2,207	363	.....	.....	.....	.....
Great Britain	10,066	896	6,150	683	9,430	853	7,104	816	9,694	1,015	.....	.....	.....	.....
Italy	445	65	198	37	620	72	701	92	222	36	.....	.....	.....	.....
Netherlands	149	28	128	26	574	80	378	69	690	83	4,011	.....	206	.....
Norway	759	65	1,666	141	1,270	117	112	21	63	10	.....	.....	.....	.....
Austria-Hungary	2,259	328	6,213	573	1,745	258	2,161	325	1,596	332	*1,999	.....	1,086	.....
Sweden	522	80	939	108	483	86	293	66	497	89	1,101	.....	.....	.....
Switzerland	1,447	272	1,545	308	2,945	491	3,913	731	4,120	718	741	.....	1,294	.....
United States of America	25,485	3,661	32,199	4,594	41,938	5,172	53,994	7,126	41,995	5,804	.....	.....	.....	.....
Other Countries	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,253	.....	2,210	.....
Total	45,478	5,988	52,349	6,917	64,328	7,848	75,036	10,161	64,270	8,911	10,105	**	5,121	14,206

*Austria only. **No value given for 1920. ***Statistics are for period May to December inclusive for 1921.

S. A. E. Production Meeting Papers

Abstracts of Eight of the Principal Papers Presented at the Production Meeting of the Society of Automotive Engineers, Detroit, October 26-27

Some Causes of Gear-Tooth Errors and Their Detection

By K. L. Herrmann
Engineer, Studebaker Corporation of America

IT IS THE purpose of this paper to show that production variables have a much greater influence on gear sounds than changing pressure-angles, steel or tooth-form details; also, by showing the errors present, to obtain definite help from the gear-cutting tool and the machine designer. We will confine this discussion, for the time being to the transmission, which is the simplest type of gearing used in the motor car.

It is not sufficient to check gears for spacing error from tooth to tooth. It is very desirable to check the accumulated error of a number of teeth, because a gear may vary 0.001 in. from tooth to tooth. With eight successive teeth each gaining 0.001 in. on the side of the gear and a similar number of teeth that may be losing 0.001 in., a total error of 0.016 in. might be imparted to the driven gears.

Figure 1 illustrates a very simple device that has been used for checking tooth spacing. The gears are mounted on a bushing and one tooth comes against a stop. A dial indicator is arranged so as to be in contact with some tooth one-fourth, one-third or one-half way around the gear. When the dial indicator is set at zero, with the tooth against the stop at any one point, the distance between the two points can be measured and, if the gear be correct for indexing, placing any of the two teeth in the gear in similar positions should not cause the dial indicator to vary, especially if the gear runs true.

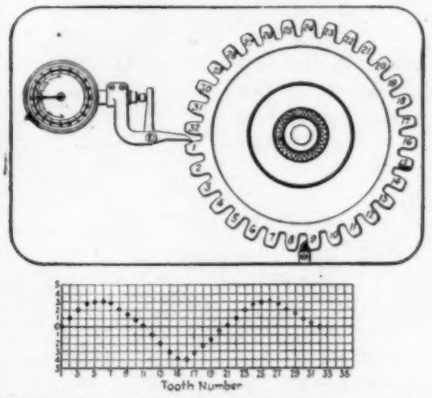


FIG. 1—CHECKING TOOTH SPACING

When the gear is first put on the indicating apparatus, the dial indicator is set at zero. We then put a mark at zero on the chart in Fig. 1 for tooth No. 1. The next step is to index the gear around one tooth. Any reading obtained is marked above the tooth number in the vertical line. We next index the gear around to tooth No. 3 and again mark the dial-indicator reading opposite the number of thousandths of an inch that it may show. The gear is then indexed to teeth Nos. 5, 6, etc., until all the teeth on the gear have been indexed.

For the purpose of record, we now have a chart showing the accumulated variables. It will be seen from Fig. 1 that at no point is the spacing variable as great as 0.001 in. between any two teeth, but it can be in error a total of 0.008 in. or more when the error between the several teeth has accumulated.

Hum or sing is not nearly so difficult to analyze as the matter of rattle in a transmission gear. If the teeth are not correct in shape and the gears are under a slight load, there may be 250 blows per sec. under certain conditions, which we are told corresponds to the tone of middle C on the piano. Should fewer teeth go into and out of mesh, and this may be caused by a slower speed, a much lower pitch can be produced.

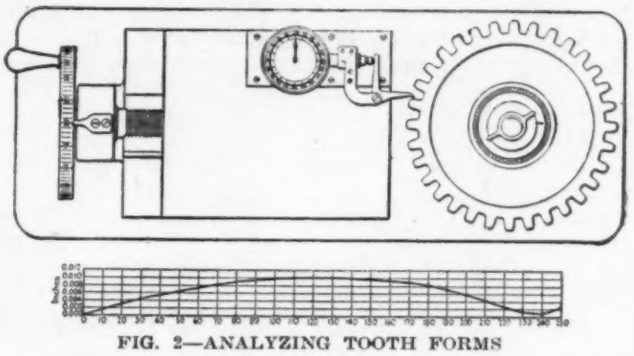


FIG. 2—ANALYZING TOOTH FORMS

In a similar way, because of the speed reduction that occurs in the usual type of transmission between the drive pinion and its countershaft, the tone produced by the reverse idler is very low and, instead of producing a hum or sing, it will produce what we usually call a growl. Errors in the sliding gears, because of their higher speeds, will produce higher pitch growls and approach a hum.

A great many instruments have been developed for the purpose of analyzing tooth-forms producing these sounds. The one that we have worked out and have

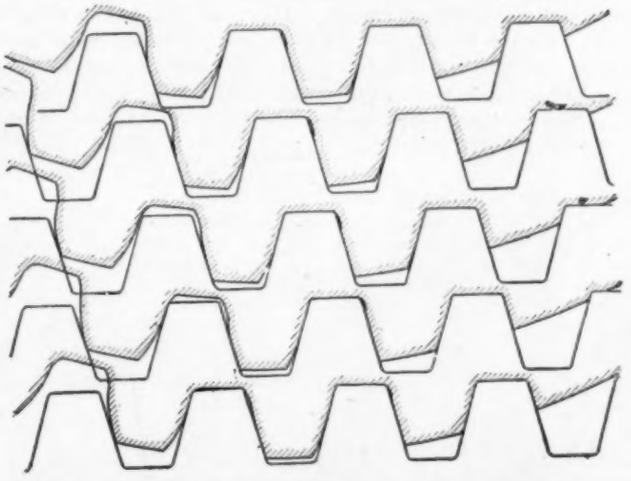


FIG. 3—OUTLINE OF TOOTH FORM PRODUCED BY HOBBING

chosen to use is shown in Fig. 2. It consists of a dial indicator mounted on a guided slide. We place the gear in a definite positon with respect to the indicator, start at the point of the tooth and set the indicator at zero.

The slide is then moved toward the gear 0.010 in. and the indicator-reading marked on the chart shown in the lower portion of Fig. 2. The slide is then moved 0.010 in. more, the reading is marked again, and this is continued until the bottom of the tooth is reached. By taking the gear that has just been charted off the bushing and placing another gear in its place, other tooth-forms will be compared with the first.

The causes of the errors referred to are various. Some of them occur in hardening, some in the cutting machines and some in the cutters. We have found these errors in all of the types of machine that we have used. For the purpose of this discussion we are selecting a hobbing machine.

The hob is a generating tool that produces a gear such as is shown in Fig. 3. It will be seen readily that if all tooth-heights of the hob are the same, each hob-tooth

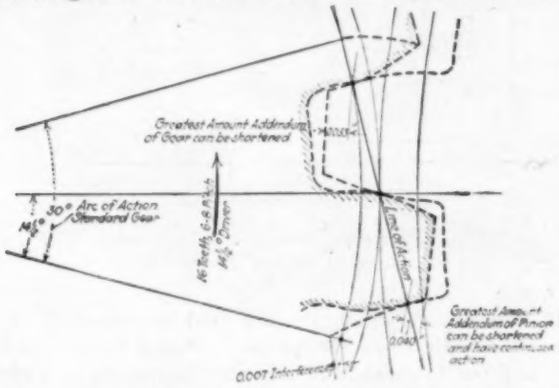

Greatest Amount Addendum of Gear can be shortened
30° Arc of Action Standard Gear
Line of Action
Greatest Amount Addendum of Pinion can be shortened and have contact on
0.007 Interference

FIG. 4—LAYOUT TO DETERMINE TOOTH LENGTH

generates, roughly, a flat in the tooth-form. If any one of the teeth in the hob is high, a wider flat will be produced. Should the tooth-heights be correct and the hob be mounted in the machine with a run-out, a leaning tooth can be produced, depending on the sideways setting of the hob with the gear. Also, should the hob be correct and the end-thrust collar in the hob spindle be out of parallel, giving the hob a slightly reciprocating motion with each revolution, an error can be produced that may compensate for the hob run-out or may add to it.

Should the thrust collar at the rear end of the spindle be adjusted loosely so that the spindle may have end-play, the hob, as it cuts on one side, will be forced over and then back with each tooth of the gear and produce corresponding errors in the tooth-form. Again, if the

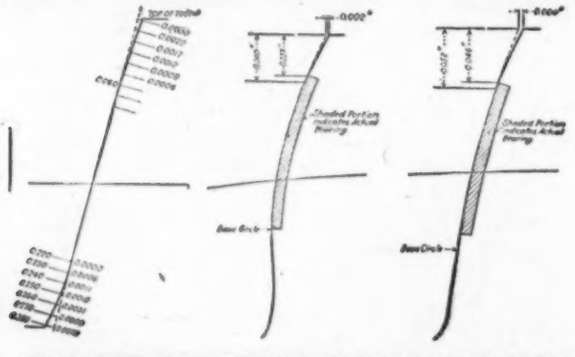


FIG. 5—HOB FORM SELECTED FROM LAYOUT. FIG. 6—TOOTH FORM OBTAINED FROM HOB OUTLINE

gears in the hob-grinding spindle have inherent index-errors in them, or should the gears driving this gear be concentric or improperly spaced, their errors will be transfered to the different teeth of the gear being cut.

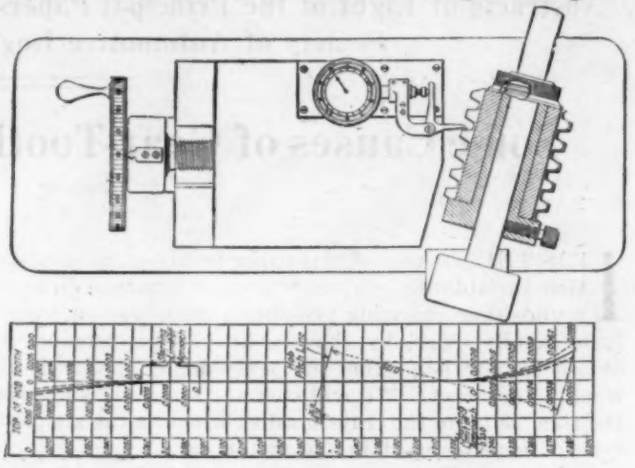


FIG. 7—HOB CHECKING DEVICE

Another important element in connection with the hob is the fit of the hob spindle.

We will all agree that, should the hob spindle be tight for a certain portion of the revolution and loose for a certain other portion of the revolution, a sagging will occur in the driving-gear train which will be very detrimental to the tooth-form. Some hobbing machines are built so that the bevel gears in the hob drive-spindle give a thrust in the opposite direction to that given by a spiral pinion driving a hob-spindle gear. This permits a back-and-forth movement of a hob-spindle drive-shaft and sometimes leaves its impression on the tooth-form.

Without going into the details concerning the other gears in the hob-spindle train, we might consider the influence of the thrust collar on the fits of the work spindle. In most hobbing-machines the bearings are kept fairly tight, and a great many operators insist that the hob spindle be kept warm. This also applies to the worm-shaft driving the wormwheel and, to a certain extent, to the work spindle.

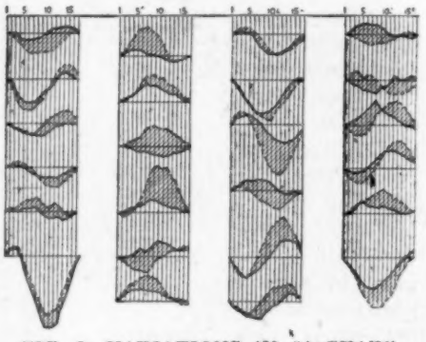


FIG. 8—VARIATIONS IN 24 GEARS

Unless the machines are extremely well adjusted, the thrust collars on the spindles so fitted score very easily and cause the spindles to be tight or loose at various portions of their revolutions. This causes a corresponding sag in the gears driving the index wormwheel and seems to be the main cause of the index errors already referred to. Another source of error is looseness in the gibs of the hob saddle.

It is very difficult to move the hob slide across the face of the tooth without having some play between the gibs. This amounts, in a very similar manner, to the error that is obtained by having end-play in the hob spindle. Another contributing error to tooth-form is depth of cut. There will be considerable error in the

tooth-form if the hob is sunk several thousandths of an inch too deep.

Should the hob be straight-sided, the pressure-angle will increase with the depth of the cut and decrease as it is raised above the pitch-diameter. Another factor having considerable influence is the outside support for the hob spindle. We have had considerable difficulty in placing this outboard support of the hob spindle back in exactly the same place, giving us exactly the same condition of hob spindle as before.

When the work spindle is caused to rotate ahead of or behind its proper position, we necessarily have certain tooth-form errors in addition to index errors, and also in addition to those produced by the hob, its spindle and driving mechanism. There are conditions under which some of the errors referred to are counterbalanced by other errors. There are conditions, however, in which these errors accumulate. Considering the number of gears in a hobbing machine and the number of possibilities for errors outside of these gears, it is largely a matter of chance whether suitable combinations can be obtained to produce proper tooth-forms.

Details of Tooth-form

The details of tooth-form are of some importance. Continuing with transmission gears, Fig. 4 shows the first layout which we make. This is with a view to determining the amount of tooth length necessary to give a 100-per cent arc of contact. With this information in hand, we select a hob form such as is shown in Fig. 5 and, using this on paper, we roll out two tooth-forms as shown in Fig. 6, one for each of the gears that are intended to be in contact with each other. The next step is to roll these gears on each other to determine the interferences, if any, and the amount that they are topped-off; then, if necessary, the hob form is modified and the same procedure carried through. When the hob form is established on paper in this manner, it is charted as shown in Fig. 7 and the hob supplier is asked to conform to this shape. Definite tolerances are given for the amount of variation from this form. On receipt of the hob, we inspect this form on a hob-checking apparatus very similar to that which we use for checking gear-tooth forms, a drawing of which is shown in Fig. 7. If these conform to our standard requirement, it is expected that the hob will be satisfactory.

Hardening of Gears

Relative to the errors produced by hardening, we have prepared a number of charts showing the condition of the gear in the green and the condition of the gear in the hard. The question as to whether oil-treated steel is better than carburized is still unanswered as regards warpage. We have hardened more than 5,000 gears of different brands of steel and carefully checked them. We find that there is very little difference in the warpage under the same hardening conditions.

The necessity for grinding gear-tooth forms depends largely on our ability to cut and harden gears, maintaining definite shapes. However, there is a large difference in the number of rejections that we have from gears ground by different processes. Our reports at this time show that out of 5,000 gears ground by one method we have had a 14-per cent rejection. This is slightly greater than that which we have had from the hob gear without grinding. By another method of grinding of a similar number of gears, we have had less than a 0.5-per cent rejection, as well as more satisfactory gears. In the first case, four gears of the transmission were ground, and in the second case only two gears of the transmission were ground. All transmissions were passed by the same inspector and inspected to the same standards. We, of course, are looking forward with great interest to the continuation of our experiment on gear-grinding.

Some Unique Features of Automobile Production

By William Dunk
Production Manager, H. H. Franklin Mfg. Co., Syracuse, N. Y.

All engineers realize that there are a large number of problems to be met in the production of automobiles, and that the majority of these problems are much the same with the H. H. Franklin Mfg. Co. as with any other. I will endeavor, therefore, to confine this discussion to the following topics that are somewhat unique in Franklin automobile designs; namely, (*a*) the production of air-cooled cylinders, (*b*) the making of case-hardened crankshafts, (*c*) the machining of duralumin connecting-rods and (*d*) experiments with hot-swaged rear-axle drive-shafts.

Production of the Air-Cooled Cylinder

The design of the Franklin engine necessitates the use of unit-cylinder construction rather than the regular block-cylinder design. This fact makes the production of the cylinder a somewhat different problem from that of machining a block casting. In the Franklin cylinder, the head is cast integrally with the body of the casting and steel cooling fins are cast in the outer surface of the cylinder-wall.

The foundry practice in connection with the production of these castings is of interest. The mold is composed of three distinct sections, the lower section being an assembly of dry-sand cores for making the head of the cylinder and the valve ports. Next above this section is a green-sand section containing the cooling fins, and the upper section of the mold is a green-sand section for the neck of the cylinder between the cooling fins and the bottom flange, the cylinder of course being cast in an inverted position. The core assembly for the head of the cylinder is made up of five unit-cores, made separately and assembled by pasting-in an accurate pasting jig so that the valve port cores are held accurately in position while drying. The valve-port cores are provided with prints to locate the upper end of the main cylinder-barrel core. For this reason it is necessary to be very accurate in the location of the port cores.

The cylinder pattern is milled longitudinally with the proper number of gooves to receive the vertical cooling-fins. These grooves are $\frac{1}{8}$ in. in depth, which corresponds to the amount that the fin is imbedded in the cylinder-wall. The green-sand section of the mold containing the cooling fins is made on an air-operated jar ramming-machine provided with a sand hopper directly above the mold. A very small amount of sand is used in this section of the mold, not over 2 in. of sand being provided outside of the diameter of the

cooling fins. The fins are held in place in the cylinder pattern by simply wrapping a piece of soft iron wire around them and twisting the ends tight. This wire remains in the mold until the casting has been made, and serves to keep the section of green sand that lies within the cooling fins from sagging below the rest of the mold. The upper section of the mold is also made in green sand and is located on the center section by taper dowels. The last operation in making the mold is the placing of the cylinder-barrel core and the strainer-gate core through which the metal is poured. The cooling fins are made of ordinary cold-rolled strip-steel which has been tinned and folded to a right angle about $\frac{1}{8}$ in. from one edge. These cooling fins, when placed radially about the cylinder pattern, form a completely enclosed air-jacket.

The greatest source of casting loss that we experience in making this piece is caused by loose flanges. Unless the flanges extend at least $\frac{1}{8}$ in. below the surface of the cast iron, they will not be properly held in place.

The analysis of iron used in making the Franklin cylinder is approximately as stated in Table I.

TABLE I—ANALYSIS OF IRON USED IN THE FRANKLIN CYLINDER

Constituents	Per Cent
Silicon,	2.00
Phosphorus,	0.50
Manganese,	0.50
Sulphur,	0.10
Carbon,	3.25

The machining operations are as follows: The cylinder casting is first mounted in a chucking fixture on the table of a small vertical boring-mill, and the bottom flange is faced and counterbored. This counterbore is used for locating the cylinder while drilling the four hold-down holes on the second operation. These hold-down holes are used for locating the cylinder for the boring operation, which is performed next. Our present method of boring the cylinder consists of making four separate cuts in the cylinder under a single-spindle Baker boring-machine. The necessity of making this number of cuts is caused by the fact that the cylinder-wall has no support to prevent its being split, if a heavy cut were attempted. The thickness of the metal of the finished cylinder between the cooling fins and the cylinder bore is only $\frac{1}{8}$ inch.

A new cylinder-boring machine has just been completed and tested which makes five separate cuts in the cylinder, operating on five separate cylinders simultaneously. The first spindle of the machine rough-bores, and removes about $\frac{1}{8}$ in. of metal from the cylinder-wall. The second spindle rough-bottoms the cylinder to within $\frac{1}{32}$ in. of the finished depth. The third spindle semi-finish bores, and leaves 0.035 in. of metal for finish-boring. The fourth spindle finishes the bottom of the cylinder to depth, and the fifth finish-bores to grinding size. We are leaving about 0.007 to 0.010 in. of metal for grinding at present, and we may find it possible to reduce this to a maximum of 0.005 in. The fact that we are dealing with unit cylinders allows us to center each cylinder very accurately for the grinding operation. The complete boring operation as performed by the new cylinder-boring machine occupies about $1\frac{1}{2}$ min. per cylinder.

The cylinder is ground on the standard type of Heald cylinder-grinding machine equipped with a special small table for unit-cylinder work. It is held against an ordinary angle-plate grinding-fixture, and is located with a plug through a master bushing inserted in the grinding fixture. Cooling water is flowed on the outside of the cylinder during the grinding operation. The valve ports in the cylinder are reamed holes about $2\frac{1}{2}$ in. in diameter and 1 in. in depth. They are held to a limit of 0.001 in. to provide a sufficiently tight joint with the extension pieces that attach them to the suction and exhaust manifolds. A special double-head machine was built to bore and ream the port holes with accuracy required.

Briefly this machine consists of two three-spindle movable-heads operating toward a central holding-fixture on which four cylinders are mounted. There are three working positions and one loading position. The central fixture is arranged so that it can be indexed at the end of each stroke of the machine. The first pair of working spindles rough-bores the port holes to within 0.035 in. of the finished size. The second spindle does not remove any metal from the diameter of the hole but simply performs the bottoming operation. The third pair of spindles finish-reams the holes to size. By arranging the machine to operate on both ports at once, the thrust of the cutters has been neutralized almost exactly, because the ports lie nearly opposite each other across the cylinder casting. The cutters used in this machine for all operations are a standard type of shell-end mill, and they seem to give very satisfactory results. It is not necessary to change cutters oftener than one set to each 350 cylinders. The capacity of this machine is one complete cylinder every 40 sec. A particularly rapid means of loading and unloading the cylinder is necessary, to allow the operator to perform these operations during the cycle of the machine.

The valve-stem guides are separate castings machined complete and pressed into place in the cylinder casting, the final reaming operation being performed in the valve-stem holes after the guides are pressed-in. The seating and other minor operations on the cylinder are performed in the usual manner and do not require any special mention.

The Case-Hardened Crankshaft

Another interesting manufacturing detail is the Franklin case-hardened crankshaft, which we have been producing for the past two years. The primary object in incorporating this type of shaft is naturally to prolong the life, so far as possible, of the bearing surfaces. Preliminary experiments developed the fact that if a crankshaft can be hardened to a scleroscope hardness of between 80 and 100, the life of both the main bearings and the crankpin bearings can be prolonged considerably. In some of our test cars as much as 50,000 miles was covered without any adjustment of bearings being necessary.

In putting a proposition of this kind into production, a number of problems had to be met concerning which very few data were obtainable. The crankshaft forging has a carbon content of from 0.15 to 0.25 per cent and the required depth of carburization is specified at $\frac{1}{8}$ inch.

In the manufacture of this shaft, the forging is first machined to within 0.040 or 0.045 in. of its finished diameter, with the exception of the flange and threaded ends which are left in the rough. The forging is then ready for the copper-plating operation, which is applied to prevent carburization of all parts of the shaft except the bearing surfaces. Several ideas were tried out in connection with preventing the copper-plating of these surfaces during the process, and we finally adopted the method of wrapping all bearings with pure gum rubber

held in place with clips. The rubber bands are easily removed and can be used again and again.

In carburizing the shafts they are packed, three in a box, in nickel-alloy carburizing-boxes, using either Q alloy or thermalloy. The approximate size of the carburizing boxes required is 12x44 in., and about 18 in. deep. A liberal amount of carburizing material is provided around each shaft. The boxes are sealed with the regulation cement and are loaded into the carburizing furnaces by a specially constructed charging truck, each furnace-chamber having a capacity of six boxes and each box having a total weight, loaded, of about 800 lb. The carburizing period necessary to get the required depth of penetration is between 22 and 24 hr. The use of nickel-alloy boxes seems to have a decided tendency to reduce the number of hours required to get this penetration.

Machining After Carburizing

At the end of the carburizing process, the shaft is returned to the crankshaft-machining department, where the flange end and the threaded end are machined, roughly, to the finished dimensions, this operation having the result of removing all of the carburized surface. This allows for the machining of these parts after the shaft has been hardened.

The shaft is then returned to the heat-treating department and reheated in a gas-fired furnace to a temperature of 1,420 deg. F. To keep the shaft as nearly straight as possible during the quenching operation, a hinged type of quenching die was devised that permits rapid loading of the shaft as soon as possible after removing it from the furnace. This die is of very heavy construction, and is handled by an air hoist. The shaft is quenched in water at main temperature, and comes from the quenching operation usually not over $\frac{1}{8}$ in. out of straight. It is necessary to straighten the shaft carefully at this point, before proceeding with the semi-finish and finish-grinding operations.

We have found it necessary to divide the finish-grinding operations into semi- and finish-grinding so as to use a rather coarse soft grinding-wheel for the semi-finish grinding in bringing the shaft to the finish-grinding size. The last 0.005 in. of metal is removed from the shaft with a very fine soft wheel to get the required smoothness of finish.

One somewhat uncertain feature that we always meet in the production of this shaft is the amount of shrinkage that will take place in the hardening operation. It is necessary to anticipate this, and to provide for it in machining the soft shaft. Our experience has shown that this shrinkage varies to a considerable degree. Our normal allowance in the overall length of the shaft and the spacing of the bearings is about 0.035 in. for a 5½-in. center-distance between cylinders. We find that this allows us to finish the shaft within the limits required for length, in the majority of cases.

Our scleroscope-hardness requirements of 80 to 100 give us a shaft that has exceptionally long life. I neglected to state, however, that the point of contact of the quenching die with the shaft produces very small soft spots; but they do not seem, as a rule, to interfere with the general durability of the bearing surfaces in any way.

The Franklin connecting-rod is an aluminum-alloy forging, either of duralumin as furnished by the Baush Machine Tool Co. or of 17-S alloy furnished by the Aluminum Co. of America. This aluminum alloy contains the elements given in Table II.

TABLE II—ANALYSIS OF ALUMINUM ALLOY IN THE FRANKLIN CONNECTING-ROD

Constituents	Per Cent
Copper,	3.50
Manganese,	0.20
Magnesium,	0.25
Iron, not more than,	0.75
Silicon, not more than,	0.75

The elastic limit of the forging is between 30,000 and 35,000 lb. per sq.in.; the ultimate-strength is between 50,000 and 55,000 lb per sq.in.; and the elongation is from 15 to 25 per cent.

The forging is heat-treated by heating it to 920 or 940 deg. F., and is quenched in boiling water. It is then allowed to age about one week to bring it to a scleroscope hardness of 90 to 100.

We use about the following procedure in machining the duralumin forged connecting-rod. The forging is first coined under a heavy toggle-press, bringing the length of the wristpin and crankpin ends to within 0.025 in. of the finished size. It is then loaded onto a special fixture on a Blanchard grinding machine that has alternate roughing and finishing stations. It is ground first on one side, then removed from the roughing station, moved to the next adjacent station and finish-ground on the other side. A special multiple-spindle boring and reaming machine having an indexing table is used for boring and reaming the wristpin and crankpin holes. The operations which this machine performs are to rough-drill, rough-ream and semi-finish ream.

The action of the forging in these machining operations is similar to that of mild steel. The power required to drive the drills and reamers is approximately the same as the power we employed formerly with our steel connecting-rod, and the cutting speed does not exceed that for steel by more than 25 per cent. In machining this forging, it surprised us to find that it machined so nearly like a steel rod. We had anticipated being able to machine this rod at a much greater speed than we found possible. The extreme toughness and wire-like quality of the chips are convincing proof that the metal with which we are dealing is something more than ordinary aluminum.

Other Machining Operations

The forging is next drilled for the rod bolts and is then put over a multiple fixture for parting the cap from the rod and facing the seats for the bolts and nuts. A broaching operation follows for providing slots in which the lower-end babbitt blocks are locked. These babbitt blocks are forced into place and broached to their semi-finished size in an ordinary two-spindle broaching-machine. The finishing of the wristpin end of the rod has been rather difficult, because it is impossible to ream a sufficiently good wristpin hole in the bearing end. Our present method of handling this operation is to semi-finish ream this hole, removing about 0.025 to 0.030 in. of the diameter, then to use a final reaming operation that removes about 0.005 in. and a final burnishing operation that is done with a high-speed burnishing-tool under a copious flow of regular medium automobile motor-oil. We find that by leaving a uniform amount of about 0.005 in. on the diameter we can produce a highly burnished surface in the wristpin hole and maintain very uniform size.

However, to obtain the fits required by our engineering department between the wristpin and the connecting-rod, it is necessary to do a certain amount of wristpin selection. When it is finally finished, the alignment of this rod is held to a limit of ±0.005 in., measured between the ends of arbors 12 in. long.

The finishing to size of the lower end of the rod is left until it is ready for assembly with the crankshaft. This operation is performed on a special type of boring machine in which we use boring bars of five separate diameters, increasing their diameters in steps of 0.00025 in. from the minimum size required up to the maximum; this allows us to cover the entire range in the crankpin bearings with the proper amount of oil clearance. At this time we use an oil clearance of about 0.001 in. for this bearing.

The weights of the finished connecting-rods run very uniform, it being necessary to maintain but two standards of weight to keep within the limits specified by our engineers, which are a variation in weight of any two connecting-rods on an engine of not more than 0.2 ounce.

Hot-Swaged Rear-Axle Driveshaft

We have been experimenting for the past 18 months with the production of driveshafts by the hot-swaging process but, up to the present, we have not felt justified in following this method of manufacture in large production quantities. The saving in the amount of material used to make a rear-axle driveshaft, together with the reduction in the amount of labor required by this method, make it a very attractive proposition, and we are not at the present time inclined to give up the idea without a struggle.

Troubles have developed in the source of our experiments. We have been unable to obtain a swaging machine heavy enough to withstand the load put upon it by an operation of this kind. We had experienced continued breakdowns of our original machine, and we have practically rebuilt it. The problem of producing a swaged shaft, without having the finished product show any twisting effect whatever from the swaging, has been difficult.

In performing the second swaging operation, which consists of necking the shaft below the diameter of the splined end, we have not been able to reheat for this operation without excessive scaling, which mars the appearance and reduces the strength of the finished shaft. The procedure that we are following at this time requires three separate swaging operations and three separate heats for making them. If it were possible to take the shaft directly from the first swaging operation and bring it up to swaging temperature again, which is about 2,000 deg. F. in our case, and to perform the second or necking operation immediately, we believe we could reduce the amount of twisting and the amount of scaling that we experience at present. The third swaging operation, that of producing the taper and the threaded end, is comparatively simple and gives us no trouble.

We are now considering the installation of a much heavier swaging machine. We find it can be built to order for us. We are considering also the installation of a second furnace to be used as a booster between swaging operations Nos. 1 and 2. With this proposed new equipment, we should be able to produce a very satisfactory product. We would be very glad, however, to learn of the experiences of some of the other automobile companies in producing a hot-swaged rear-axle driveshaft.

Experience Notes from a Production Notebook

By H. J. Crain and J. Brodie
Production Department, Packard Motor Car Co., Detroit

THE experiences recorded in this paper have not been selected in accordance with a specific plan. No attempt has been made to cover any particular subject fully or to arrange the different descriptions with regard to a related sequence.

The increasing congestion on city streets and the seriousness of the automobile accident and collision situation should be convincing evidence of the need of proper adjustment of motor-car brakes. It would seem important that cars should be shipped from the factories with the brakes seated and adjusted to overcome the rapid wear that usually occurs in driving the first few hundred miles. This rapid wear is caused by the ironing or smoothing of the brake-lining surface until the high spots have been worn down to the level of the rest of the lining face. It may be due also to slight imperfections in the contour of the brake-band. Two motor-driven machines were designed and built by the Packard company for the purpose of running-in brake-bands, one for the internal or expanding brake and the other for the external or contracting brake. The brake-drums rotate at a speed of approximately 1,000 r.p.m. in both cases. The drums are cooled by water, circulated about the peripheries so that the temperatures are never excessive. Pressure is exerted on the brake-bands by a weighted lever, the weight being adjusted so that the pressure is only great enough to assure a full bearing of the band on the drum. Each band is run for about 1 minute. It will be found that the bands acquire a polished surface on these machines, and that the irregularities sometimes existing around the rivet-holes and throughout the lining surface are smoothed-out. By taking this precaution at the factory the maximum brake efficiency is attained at the beginning of operation of the car, and the adjustments usually required in a new car after a few days of service are unnecessary.

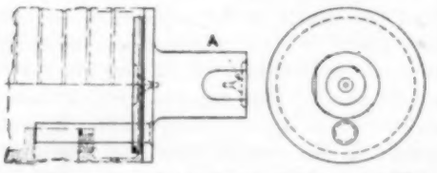


FIG. 1—THE MANDREL THAT CAUSED TROUBLE

The importance of accuracy in grinding a piston skirt is recognized by all production men. The center, shown in Fig. 1, was originally used in the Packard shops for centering and driving the pistons during the external grinding operation. Excessive wear of the surface *A* necessitated the frequent replacement of this center and demanded constant supervision by the foreman in order that the work should not be spoiled by

continuing the use of a center that had passed the permissible stage of wear. The study given to this small puzzling problem resulted in the adoption of the mandrel shown in Fig. 2. The thrust and driving load are taken by a taper-roller bearing of heavy load-capacity, the wear is distributed over a very large surface, lubrication is easily maintained and the life of the center is greatly prolonged. The block *A* drives the piston by

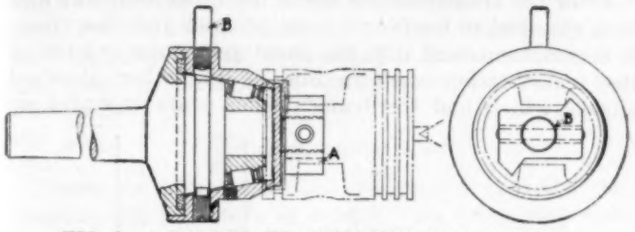


FIG. 2—A ROLLER BEARING PISTON MANDREL

the pin bosses, the block being part of the outer sleeve which is driven by the stud *B*. This design has proved very successful, and, no doubt, other tool designers could apply it to advantage.

All production and inspection departments have had the displeasure of running down peculiar engine knocks. A few years ago when a new model was started through the Packard shops the engines of the first run received at the test-stands were all found to have a perceptible piston slap or knock. Numerous remedies were tried but eventually the real cause of the noise was found largely through accident.

The click came only at the time of the explosion. Investigation revealed the fact that the valves were not centering properly in the conical surface in the cylinder. The condition is shown in exaggerated form in Fig. 3. It was found that the tool used to form the valve-seat was centered by a spindle inserted in the valve-stem guide. This spindle was too much undersize and allowed the tool to float just enough to throw the conical seat out of alignment with the valve-stem guide. As a result, the valve-spring would not bring the valve fully into the seat and the valve would hang on one side of the valve-seat until the explosion snapped the valve into the seat with a very noticeable click. Of course this part of the noise was obviated without difficulty. But this correction did not stop all the noise. A more annoying knock was eventually found to come from the piston-rings, which were of the diagonal-cut type with a slight clearance between the ends. As the explosion-pressure reached the rings they were compressed and their ends snapped. A ring that snaps in the manner described generally shows bright polished ends. When the proper end-clearance had been determined by experiment, the noise ceased. The rings in general use today have overlapping joints, but as the end clearance can be very large this trouble is not encountered.

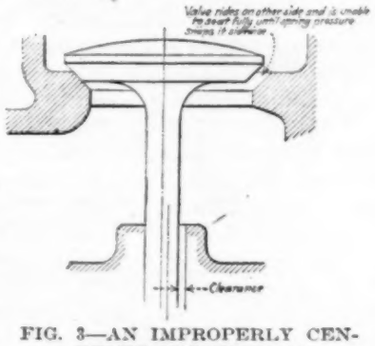


FIG. 3—AN IMPROPERLY CENTERED VALVE THAT WAS NOISY

Oil is circulated in Packard engines by a gear-pump similar to that illustrated in Fig. 4. When this particular design was first adopted it was found to produce a very irritating noise, which sounded like the blades of a fan striking a sheet of paper. Naturally this noise was attributed to imperfections in the gears. In the experiments made to abate this nuisance tooth-forms and pressure-angles were varied, and helical and herringbone gears were fitted, but the clatter persisted. All degrees of backlash were tried but without avail. It was noticed that a certain run of pumps were more quiet than the others. These were inspected carefully to ascertain what variation was responsible for the lessening of the noise. The only difference found was a slight relief on the lower face of the idler gear. At *A* is shown a feeder channel cut in the base of the pump for the purpose of carrying oil to the idler bearing through the cross channel *B*. Note that this channel is open to the pressure side of the pump but ends at the point where tooth contact ceases on the suction side. It was found that when the tooth corners were beveled, as shown at *C*, the noise was reduced. The possible effect of these changes was the basis of a careful study, which resulted in the discovery of the real source of the noise. Both these schemes eliminated the sharp cutting off of the oil stream that would naturally attempt to escape at *D* from the pressure side to the suction side of the pump. By relieving the pressure in the groove *A* the oil was not able to spurt against the tooth faces and rattle the unloaded idler gear in the backlash space in the driving gear. When, as an experiment, the groove *A* was filled with solder, the altered pump became quiet. The design of the pump was changed, the groove *A* was omitted, and no further trouble was experienced. This case is cited as an example because it indicates that gear noises are not always attributable to the gear-teeth themselves.

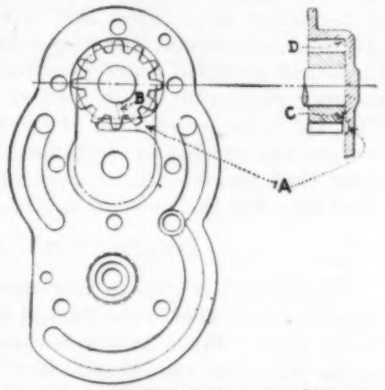


FIG. 4—THE PUMP FOR CIRCULATING LUBRICANT

The production and engineering staffs of the Packard Motor Car Co. have been studying the matter of gear noises for many years. This work is still being carried on but no panacea has been definitely discovered for gear troubles. A large number of investigations made over a period of years have led us to believe that gear noise does not always originate in variations of the gears themselves. Such variations undoubtedly contribute to the gear growl

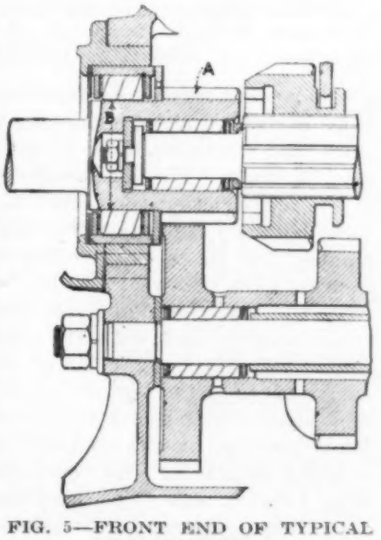


FIG. 5—FRONT END OF TYPICAL TRANSMISSION

or chatter but the noise can often be cured or dampened by an alteration of another part. We have concluded that the proper mounting of the gears on rigid shafts is a paramount requirement if noise is to be avoided. The most perfect tooth-forms, ground, shaped or milled, will not run quietly if they are carried on shafts that spring or are not in alignment.

The front end of a typical transmission is shown in Fog. 5. Particular attention is directed to the mounting of the main drive-gear *A* in which it will be seen that this is carried on a roller bearing, the inner race of which is formed by the shaft itself and the outer race is mounted in the transmission case. In the final inspection of a certain model at the Packard factory it was noticed that the degree of gear noise varied from very quiet to objectionably loud. Attention, naturally, was centered on the noisy gears. These were returned to the transmission department and torn down for careful inspection, adjustment and reassembling. Invariably the inspection revealed gears, bearings and shafts that were as near perfection as it seemed possible to approach. This led to the assembling of special gears in which perfection was carried to the utmost degree, a state far beyond that possible under even unreasonable inspection practice. But the noise, if anything, was worse.

Locating the Trouble

It remained for us to tear down and inspect several transmissions that were passed in the final car-test as being quiet. When this was done it was found that the roller race on the shafts had been ground to low-limit diameter, while the roller race in the shells had invariably been ground to the largest or extreme high limit specified for these holes. For purposes of comparison, six noisy transmissions were then torn down, the bearing diameter *B* was ground approximately 0.001 in. under the former low limit and the transmissions were reassembled and tested. This change caused the noise practically to disappear.

Experiments were made repeatedly with noisy transmissions and, in every case, when this alteration was made and the bearing clearance was increased, the noise was either entirely eliminated or reduced to a degree that was not objectionable. We concluded that this result was produced by providing sufficient space for an adequate oil-film. Further experiments along similar lines have substantiated this conclusion.

Providing the Remedy

The remedy seemed a simple one to apply but we were quite concerned about mounting a bearing under conditions that simulated those it would assume after several months' wear. We had always supposed that bearings of the anti-friction type must be mounted snugly. Before definitely adopting the new practice, wisdom demanded that we check the effect of the greater diametral clearance on the wear of the bearing. Transmissions were run under similar conditions with the standard or snug bearing and with the increased clearance. We found that the snug bearing wore rapidly during the early stages of the test and eventually reached the state of looseness with which the other bearings started. The loose bearing, on the contrary, practically retained its original clearance. We concluded that the wear of the snug bearing was accelerated because of the absence of an oil-film sufficient for complete lubrication. The loose bearing apparently accumulated an adequate oil-film and the wear was normal. The test was continued for some time and frequent examinations showed that the snug or full-fitting bearing continued to wear faster than the loose one. This, we believe, is due to the heavy initial wear that breaks or distorts the ground surface instead of glazing it as seems to be the case when the bearing is assembled with a proper clearance at the start.

After the transmissions using the roller bearings had been changed to conform to the practice just described, it became apparent that the same gear-noise existed in the transmission used in one of the other Packard models which had the transmission gears mounted on

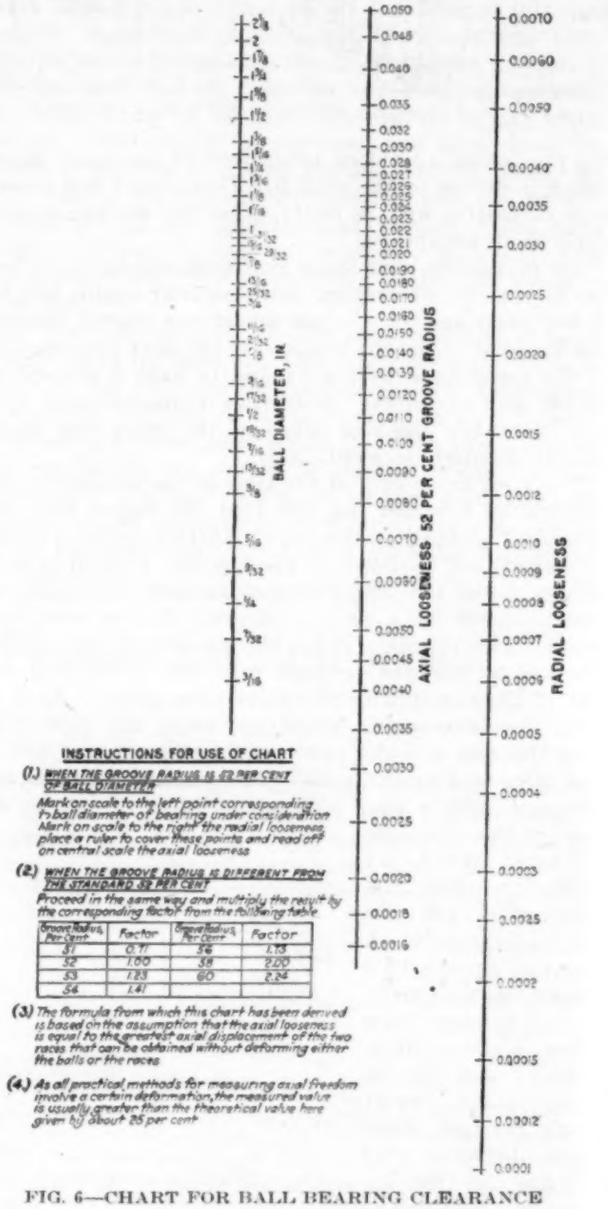

BALL DIAMETER, IN.
AXIAL LOOSENESS 52 PER CENT GROOVE RADIUS
RADIAL LOOSENESS
INSTRUCTIONS FOR USE OF CHART
(1) WHEN THE GROOVE RADIUS IS 52 PER CENT OF BALL DIAMETER
Mark on scale to the left point corresponding to ball diameter of bearing under consideration. Mark on scale to the right the radial looseness, place a ruler to cover these points and read off on central scale the axial looseness
(2) WHEN THE GROOVE RADIUS IS DIFFERENT FROM THE STANDARD 52 PER CENT
Proceed in the same way and multiply the result by the corresponding factor from the following table
Groove Radius, Per Cent | Factor | Groove Radius, Per Cent | Factor
51 | 0.71 | 56 | 1.73
52 | 1.00 | 58 | 2.00
53 | 1.23 | 60 | 2.24
54 | 1.41
(3) The formula from which this chart has been derived is based on the assumption that the axial looseness is equal to the greatest axial displacement of the two races that can be obtained without deforming either the balls or the races
(4) As all practical methods for measuring axial freedom involve a certain deformation, the measured value is usually greater than the theoretical value here given by about 25 per cent

FIG. 6—CHART FOR BALL BEARING CLEARANCE

ball bearings. We altered a few experimental ball-bearings by deepening the grooves in the races to allow a minute clearance for the balls, instead of assembling them to a good rolling-fit or to the fit of the standard stock. This was done to provide oil clearance, as had been done with the roller bearings. When the loose ball-bearings were substituted for the tight ones in noisy transmissions, our previous experience was repeated and the noise decreased.

It was a comparatively easy matter to determine the

clearance needed in the case of the roller bearings since diametral clearances could readily be measured. It was found to be difficult, however, to measure radial clearance in the ball-bearing races and we were forced temporarily to determine the degree of clearance by the end-play or axial looseness. A maker of ball bearings prepared the chart, reproduced in Fig. 6, for the purpose of converting a desired radial clearance into the equivalent axial play. This enabled us to order bearings with a selected radial clearance, which could be held uniform without demanding a finer tolerance from the bearing maker, and cured the gear noise most effectively.

Backlash and Noise

From the two cases cited we judged that the same reasoning might apply in determining the proper allowable backlash in gear-teeth. Here, again, there is a possibility of not providing sufficient room for a film of lubricant, of squeezing all the oil out of the meshing space, and of causing increased noise. Experiments with gears identical in every respect, except in the amount of backlash showed, that a very evident drop in the noise of the gears was produced when the backlash was increased to a certain point.

It has been our experience that whenever you silence one noise in a car, another becomes evident that never caused complaint before. The eventual attainment of silence is the result of a persistent noise-curing campaign which starts with the noise that is most noticeable and works down the line. This method has resulted in finding that the rear-axle noise still persists in most cars though in a much less disagreeable degree.

The spiral bevel-gear, originally introduced by the Packard company, was a big step in the direction of reducing rear-axle gear-noise. Until other units of the automobile had been perfected to their present state of quietness, we were satisfied that rear axles were about as quiet as they could be made commercially. We are now endeavoring to perfect the assembling of the gear units, so that the noise caused by their operation shall be reduced to the smallest possible degree.

Selection of Machine Tools

By A. J. Baker
Production Department, Willys-Overland Co., Toledo, Ohio

A PRIMARY consideration that an executive must give to any purchase, be it design, material or equipment, must of course be its suitability for the purpose intended; another is the availability of a source of supply.

The machine-tool builder, who looks toward a full utilization of his plant, will use all his engineering ability to develop some new machine, the output of which shall be so great that it will relegate to the discard all the machines previously made by him, even though they may have been so well constructed and so well used that their productive life is still a matter of several years. He will do this on the theory that you cannot afford to be without the newer machine because of the marked increase in production of the newer tool.

Those of us who select the machinery must bear in mind the type of help that will operate it. Machines that call for adjusting by hand during their operation, for accurate reading of dials or indicators, for careful setting up of the work in the machine, for a complex cycle of operations involving a developed mentality; all are to be decried; for not only do such machines limit the number of operators available, but under the stress of production, the amount of scrap that the machines will produce is always entirely out of proportion to that produced by simpler equipment.

The Special Machine

A natural development of the above line of thought leads us to the special machine. By this I do not mean the single-purpose machine, or, better still, the single-piece machine. There is a marked difference here which must not be lost sight of and our failure as an industry to keep this difference clearly before us has led to the adoption and use of some machines that cannot be regarded as wholly satisfactory from an economic standpoint.

Between the single-piece machine and the standard machine tool is the safe position. Some machine-tool builders already have recognized, and there is no doubt that others will recognize, the special needs of the automobile business. They have produced machine tools in which the feeds and speeds cannot be changed at the will of the operator, but can be changed at the will of the executive by the transposition of gears. These machines permit adjustments but only by the set-up man. They are constructed liberally along the lines of spindles, slides, gearing pulleys, and the like, and preferably are over designed for the power that they will consume. They are lubricated fully and automatically and do not require the use of the oil can. In the hands of the operator they are only single-piece machines and as such may be designed with a reserve of power and a rigidity much in excess of the more universal type of machine, because their application is not so constrained, and they can be regarded as a perpetual asset even though the model, or some detail of a model were discarded and another took its place.

Why New Machines Are Bought

We now come to the reasons for purchasing new equipment or new machines. The one most frequently encountered is that the new machine will save money. It is not always expressed that way. It is sometimes argued that the new machine will reduce the labor cost or will turn out a piece more quickly than under the old method; but these are not the real things to be considered. The only satisfactory reason is to reduce the cost and not to reduce the labor charge or increase the production per man, and in this cost reduction appears the consideration of the items that I have already touched on. The second reason is to increase production; in other words, to turn out more parts per year or per season. In this case the consideration will be whether to put in more machines of the type already in use, or to purchase some machine that was an improvement but of the same general type, or to get an entirely new kind of machine.

There is much to be said for maintenance standards. If the records show that the tool you have been using is up to the average in productivity, it would be foolish to change to another make, even if a somewhat greater

output could be shown. Unfortunately many machine tools of the same general classification differ so much in detail that the equipment of one cannot be transferred to another. The T-slots in tables, the taper hole in spindles, the thread on spindles, the form of tool-holder, the method of clamping the tools, the arrangement of the control levers all differ very widely. You are therefore forced to make up special fixtures, which differ in some details from those you have been using on other machines. This means that if a breakdown occurs, and if you have planned for it and have extra tools available, you will have had to carry just twice as many fixtures in excess of actual requirements. If you have more than one make of machine you will not have the facility of immediate interchangeability. You will not with any degree of certainty, be able to transfer the operators. The foremen will spend much more time in the instruction of the men. The time-study department will have to make changes in the times, because the speeds and feeds may differ somewhat, and it may mean that the rates set on the job and used successfully will have to be readjusted.

In summarizing, I want to make these points:

1—There is a surplus of machine-tool equipment of the standard types both actual and potential.

2—Machine-tool makers are devoting their thought to high-production single-purpose machines of standard types.

3—The craze for special machinery is passing.

4—Special machinery will not always stand a financial comparison with standard machinery.

5—We are not, as an industry, facing our responsibilities in the matter of training operative help for tool and die work.

6—When considering new equipment we cannot disregard the inventory value of existing equipment and the loss that would be shown on our balance sheet if the existing equipment were converted from productive machinery into excess machinery for sale.

7—The only good reason for installing new machinery, old machinery or any machinery, apart from those cases where a better quality is demanded, is to reduce the cost of production.

Processing Spline Shafts by a New Method

By James A. Ford
Production Department, Studebaker Corporation of America

THE general practice among manufacturers of transmissions requiring a spline shaft has been, for many years, to finish the spline and body portions of the shaft by grinding with a formed wheel after hardening; but it has been found that this process necessitates frequent dressings of the grinding wheel and demands extreme care in the obtaining and maintaining of the desired form.

Since it was desirable that these difficulties be eliminated, it was decided by the corporation of which I am a representative that the best method would be to omit the grinding operation and substitute a process that would not include these grinding troubles. Experiments along this line consequently were carried through by the methods and standardization department of our corporation, and the results of its investigation are presented briefly as follows:

The accuracy of the finished shaft is the primary thought that was borne in mind during the investigation, and the other important points considered were that the

(1) Splines must be straight, in line with the axis of the shaft, uniform in width, properly spaced and smooth on the wearing portion

(2) Body of the shaft between the splines must be round and parallel with the axis of the shaft, the diameters must be held within prescribed limits at any given portion and the surface must be smooth

(3) Entire shaft must be true in relation to its axis, of the proper degree of hardness and made of the best obtainable material for the purpose, without regard to any difficulties that this requirement may introduce into machining operations.

It was evident that other troubles would appear after departure from the grinding troubles that were experienced in the finishing of the shaft by the old process. The troubles that were anticipated were as follows:

(1) Difficulty in hobbing to exact dimensions, obtaining a smooth, even surface and maintaining a true form

(2) Liability of warpage in shafts during the process of hardening

(3) Variation in diameter due to hardening

(4) Variation in the width of the splines because of hardening

It was believed that a given allowance could be made

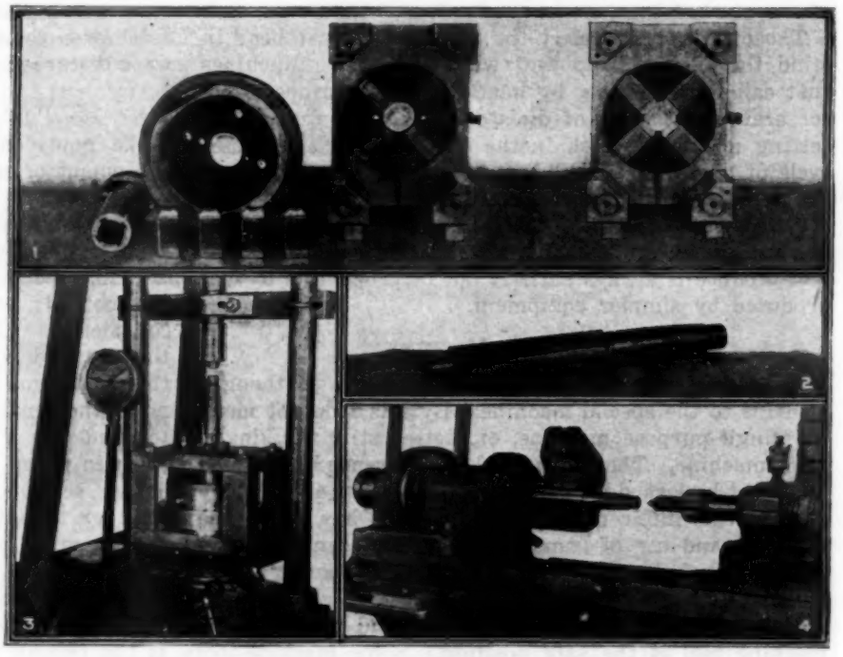


FIG. 1—THE DIE FOR SHAVING. FIG. 2—A FINISHED SHAFT. FIG. 3—HOW THE SHAFT IS FORCED THROUGH THE SHAVING DIE. FIG. 4—RE-CENTERING BY GRINDING

for shrinkage during the hardening process and that a uniform shape and size could be determined in advance. Therefore, to overcome difficulty (1), the decision was made to draw the shaft through a die after the shaft had been carbonized. It was found possible to do this by using the methods and tools that will now be described and illustrated.

The die shown in Fig. 1 is constructed according to the same principles that apply to the automatic threading-dies now in general usage, the cutters being in the position that the die chasers ordinarily would occupy. At the right cutters are shown installed in the die. The cam ring is practically of the same construction as that used on a threading die, except that the ring is made stronger. The opening feature is necessary on account of having to pass the shaft back through the die, because the body of the shaft beyond the splines is larger than the body-portion between the splines and the shaft will not pass completely through the die. This is illustrated clearly by the view of the shaft shown in Fig. 2.

The shaft is entered into a bushing that is lined-up with the die. Then the shaft is pressed through the die to a stop that has been set at a sufficient distance to permit the shaft to pass through to the shaft-neck at the end of the splines, as illustrated by Fig. 3. The cutters in the die are then released and the shaft is removed.

During the experiments with this die, it was ascertained that a clearance angle on the cutter of 30 min. was about correct, and it was decided that one pass of the shaft through the die gave the best result.

Up to this point we had a shaft that was carbonized, and its body and splines were finished to the dimensions desired. After hardening a number of shafts, we were able to determine just what change took place in them, and an allowance was made for this in the adjustment of the die. The change was uniform to a reasonable degree in all shafts, and the existence of this uniformity enabled us to determine very closely what the standard allowance should be.

The next problem was that of overcoming the warpage in a shaft after it had been hardened. Fortunately, we found that this warpage was outside of the splined portion of the shaft.

Straightening the Shaft

It was very difficult to revolve the shaft on its centers and straighten it to the degree of exactness required, and the operation required too much time. However, we found it possible to straighten the shafts easily to within 0.005 in. per ft. of being out of parallel with the true axis of the shaft. Therefore, we straightened the shafts to within the 0.005-in. per ft. limit.

After having been hardened and straightened to within the 0.005-in. per ft. limit, the shaft is gripped in a fixture mounted on the spindle of an internal-grinding machine as illustrated in Fig. 4. It is then revolved true with the splines while it is being re-centered by grinding against the pencil-shaped grinding-tool shown also in Fig. 4.

After the new centers have been established true with the spline portion of the shaft, the remainder of the operations follow ordinary shop practice.

The Group-Bonus Wage-Incentive Plan

By E. Karl Wennerlund
Production Department, General Motors Corporation, Detroit

THE subject of wage incentive is an important one to factory executives. During the past few years it has received considerable study. Nearly all factories now have their own specialists who make time-studies of operations and recommend or set production rates. Even where outside industrial engineers are employed for this purpose their services are regarded as temporary, with the idea of developing a local staff as rapidly as possible to handle the regular routine. The question of the particular form of wage incentive, therefore, becomes important. No single plan can be recommended for all factories. Local conditions and the character of product will have to govern in each case.

Until recently, the plan followed has been generally of the type known as the individual-effort plan, with either straight piece-rates or some form of premium or bonus based on time measurements. Grouping of employes was not often resorted to, except for such operations as made it impracticable to keep track of the output from individuals.

Simplifying Factory Routine

It was the desire to simplify the factory routine, and to escape from this mass of detail management without sacrificing the principles of quantity checks, that prompted the development of the group-bonus plan.

Under the group plan it would not make much difference in theory whether a fixed group-price were established or some form of bonus or premium payment were used. On the other hand, a fixed group-price in money value would offer some very definite objections if adopted as a general plan.

To obtain a clear idea of the application of group standard-time and its use as a basis for a wage-incentive plan, let us consider a single production line manufacturing and assembling pistons in an automobile-engine plant. This unit has its operations arranged in sequence, in what is known as a progressive line of manufacture. It starts with the rough-machining of the casting and ends with the finished product with piston-rings inserted. The production line includes both machine and bench-assembly operations. Parts move without a break from one operation to the next in a steady flow. Some operations may be done by a single workman, while others may have several workers in parallel, depending on the volume of production and with what detail it is practicable to subdivide operations.

It is proposed to keep no check on quantities passing intermediate operations or on those completed by individual workers on operations in parallel, but to give credit for finished pistons passing final inspection. This particular production line may be located in a department also producing connecting-rods or any other line of manufacture. Such a line embraces a production unit of the factory, and is technically known under the group plan as a *division*. Its workers are primarily interested in the production of pistons but they know little or nothing about conditions on the connecting-rod line and should not be grouped with it.

Each member of a group receives the same percentage

of bonus at the end of the pay period, but it is computed on his wage earned while assigned to the group and the total amount earned by each worker will, therefore, depend on his hourly base-rate and number of hour worked. No job tickets are used. A shop timekeeper will handle from 300 to as high as 600 group workers. A list of employes is tabulated daily for each group, and elapsed time is taken at the end of the day from the entrance time-clock. If a worker is transferred out of or into a group, a transfer slip noting the time is recorded by the timekeeper and the elapsed hours are charged accordingly. Standard-hours credit is obtained from the finished inspection reports of quantities, multiplied by the group standard-time.

A group may produce various parts having different time-standards, and therefore different direct-labor costs and, since we use no individual elapsed-time job-tickets, labor costs are computed from the group cost per standard-hour. For given base-rates, the labor cost will be constant per standard-hour and per piece for all efficiencies above 100 per cent. If the average efficiency falls to 90 per cent, the labor cost will increase less than 2 per cent.

Grouping Indirect Labor

Indirect labor has been grouped extensively wherever a "community of interest" can be maintained between workers. They must have a common interest in the results of their own efforts. Storeroom labor, unloading materials from car, boxing and loading automobiles, for shipment and similar classes of work where the effort is measurable, have been grouped with very good results.

In summarizing our experience during the past four years with the group-bonus plan, it should be borne in mind that the particular feature involved is the principle of grouping employes and not the wage-incentive table that happened to be selected. Very likely any one of several incentive plans could have been used in connection with grouping and have produced satisfactory results. This one was selected because we thought it would be more adaptable to changing factory conditions than a system of fixed-group piece-rates having their value in dollars rather than in time. It also offers the same incentive to high production as could be obtained from piece rates.

Advantages of Grouping in Operation

Although the primary purpose of grouping was to simplify the factory system and to reduce the amount of clerical detail, it developed that there were many advantages from an operating standpoint. Much less material is tied-up in process, and full advantage can be taken of the mechanical arrangement of progressive lines whereby parts are made to flow from one operation to the next in a steady stream through single or parallel operations. Under the continuous-flow method of production, the checking of quantities after individual operations becomes difficult, if not impracticable; so, the logical method seems to be to count from the end of the line and credit groups of workers. Nearly every such production line has its "neck of the bottle" or several of them. If these can be speeded up, the whole line benefits.

One of the early advantages noted was the speeding-up, or elimination, of slow workers. Hence, it has been our experience that more production per man-hour has been obtained under grouping than under a previous individual-incentive plan. From the viewpoint of factory operation it has meant the elimination of job tickets and elapsed-time records for group operations. This has meant saving in clerical detail. It has added to productive time, because there are always some delays if employes are required to keep count on quantities, obtain job tickets or furnish information to shop checkers.

Standard Versus Special Machine-Tools for Automotive Production

By R. K. Mitchell
Maxwell Motor Co., Inc., Detroit

THIS PAPER is not an attempt to dictate a set rule or policy for the tool engineer or tool designer to follow in every problem that presents itself. Rather, it is a general criticism in disfavor of the present prevailing policy of making large expenditures for special equipment when standard equipment might well serve the purpose, and also a plea for the reduction of the altogether too large investment carried under fixtures and permanent tools.

There was a time when the automotive manufacturer found it necessary to build special machines for performing certain operations and making special parts. When an operation or a part of that description was required, the policy was to design special fixtures and machine tools to meet the special conditions. But often when the original intention is only to design a special fixture, the ultimate result is a fixture or machine tool that requires special driving and feed mechanisms. Then comes the question of whether or not to design special drives and feeds for some machine that is already in the plant, and this is the critical point in the argument between special tools and standard equipment. In many instances the only machine tool that will accommodate the special heads is a machine tool designed and built purposely to meet this one particular difficulty; so, we arrive, perhaps unintentionally, at the stage we have so much desired to avoid, which is the design and fabrication of special machine-tools.

In the ordinary routine followed when building special machine-tools, we are confronted with numerous obstacles. The first is the fact that the average draftsman found in the general run of tool-designing departments has had neither the engineering nor the production experience essential to the proper designing of special machine-tools, and his lack of knowledge as to proper stresses, correct bearings, loads and the details to be employed, together with lack of foresight in considering the interchangeability of parts, ease of replacement and the use, so far as possible, of standard parts, is reflected in the enormous first cost of the majority of special machine-tools that are built under private supervision. The actual construction usually is performed in the tool room by high-priced labor, working an excessive amount of overtime, and the machine, finally completed,

has yet to meet its first test. It will be acknowledged that very few special machines have ever been devised and built that did not demand much undue expense and delay in production, not to mention the many changes made before they began to function as originally intended.

A special machine-tool for turning both sides of the flange and the face of a flywheel at one operation was designed and constructed recently at an expense of $18,000 to $20,000. Three days after the machines were installed, they were abandoned; but, fortunately for the manufacturer, the old set-up was still available. This was not because the old set-up was more efficient; but because, although there was every opportunity to devolop a machine that would give greater production, lack of foresight and poor design ruined the whole project. The worst blunder was that no provision had been made or could be made for the escape of chips. Chips from the upper cutters worked down and packed against the bottom face, impeding the two lower cutters and necessitating their removal with a chisel about every 10 min. The final outcome of this case was that the manufacturer had to go out in the market and buy standard machine-tools. If the outlay wasted in design and construction on the special equipment had been applied to the purchase of standard equipment, it would have more than covered the standard machine-tools that were afterward purchased. The result of the whole incident was that $35,000 to $40,000 was expended, where $15,000 would have served the purpose.

Disadvantages of Special Machines

A special machine-tool in production requires the services of a skilled or special operator, at least until those interested have become familiar with its care and operation. If the operator should be absent for any reason, loss of time and production must result before another man can be broken in.

Repair parts for special machine-tools are costly items. It develops not infrequently that patterns are broken, mislaid or left at the foundry and, when the casting is finally secured, it means day-and-night work in the tool room with additional expense and delay.

The most forceful argument against special machine-tools at present is the unstable design and development of automotive parts. When a designer produces a special machine-tool to accommodate a certain part, he has no guarantee as to the life of that part and, I venture to say, the average life of the majority of automotive parts, without change in design is less than 6 months.

Let us consider now some of the advantages of using standard equipment and machine tools. To-day, machine-tool bnilders have stocked the market with a large variety of simplified, standard machinery that can be adapted to special operations and parts with slight extra expense. In the first place, the standard machine-tool is very much cheaper than a special machine. It is built on a quantity-production basis, and designing and engineering charges are distributed over a greater number of units. The standard machine-tool is available for prompt delivery. It has had a thorough trial in practical work before being placed on the market, and is out of the experimental stage. Reputable manufacturers of standard machinery build their machine tools so that the parts are interchangeable and, in case of service requirements, they are prepared to furnish any part promptly from stock. Consider for a moment the money that is tied up in special machinery patterns, extra castings and the like. With a standard machine-tool in production in any large shop. if an operator is called from his machine, other men just as familiar with the operation of the machine are always available.

I believe there is ample room for improvement in the design of special fixtures. Too little attention is paid to the needs of manufacturers of standard parts whose product, if properly investigated, will be found to contain unlimited possibilities for incorporation in the design of special jigs and fixtures. In a recent issue of a popular weekly periodical. there was a full page spread. advertising the merits and possibilities of standard bushings. This advertisement alone probably meant an expenditure of $8,000 or $10,000 for that manufacturer. With dozens of companies just like this that place their engineering staffs and experience in their particular line at our disposal, still we do not pay enough attention to their claims and the merits of their products to consider them when designing our own pet tools and equipment.

So far as possible, when designing fixtures and tools, we should take advantage of all that the trade offers, and attempt to simplify our creations. The frequent use of the three fundamentals of jig and fixture work, the clamp, the V-block and the angle plate, is to be recommended.

As a recent instance, a large drum-type fixture was designed, built and installed on a machine. The cost was about $2,500, including special drive gears and the like that were constantly breaking, delaying production and running up a continuous repair bill on this job. The annoyance and continuous expense demanded immediate action and the whole fixture was replaced by two small angle-plate fixtures on which V-blocks to oppose each other were fastened. One side was loaded while the part on the other side of the fixture was being milled. These two fixtures cost about $70 and actually increased production beyond that of the more elaborate and expensive fixture. This is only one of similar instances that occur every day. I believe that the tool designer is so prone to become interested and intent on the design and construction of the fixture that he temporarily loses sight of the fact that the fixture or tool is not the ultimate issue, but only the means to an end.

The Control of Operating Tool and Supply Costs

By F. A. Mance
Production Department, Studebaker Corporation of America

A CONTROL OVER expenditures for perishable tools and operating supplies has been successfully established by rating or allotting the amounts to be used by each department for every operation. By this allotment we are able to regulate the amounts of tools and supplies used throughout the factories in accordance with the number of cars built. Each item is priced and extended, and the aggregate is totaled. The total represents the amount of money allotted to the department to produce a definite number of cars in a given period of time. In figuring departmental percentages of efficiency this amount is included with labor and production.

This system has been in operation for nearly four years and during this time the cost of renewals of perishable tools has decreased approximately 71 per cent,

though some of this reduction was due to a decrease in the cost of the tools.

To anyone interested in adopting this method we would suggest the following procedure: Start with the selection of a competent and aggressive tool-trouble man for making the survey. Provide work sheets on which to list the department, the part number, the operation, the description of both tools and supplies and the amounts allotted for any given number of cars per month. These work-sheets are afterward to be used in making up a standard form in quadruplicate. The standard form should contain additional information as to price, the extensions and the total, as previously explained. The standard allotment-sheets when completed are distributed to the foremen interested, the tool or supply stores, the superintendent of the plant and the supervisor of tools or the methods and standardization department.

Deliveries from stores are made upon approved requisitons, provided the article wanted has been previously allotted and appears on the allotment sheets. Departmental operating tool and supply reports are made up for every 10-day period by the supervisor of stores and show the amounts withdrawn during that period. They are then forwarded to the accounting department for pricing. From copies of these sheets each foreman is checked as to the amount he is runing over or under his allotment and he is allowed to see these copies during each period in order to acquaint himself with the cost of the article that he uses.

Salvaged or restored tools are carried in stock and are given out on requisiton in the same manner as new tools, with the exception that the requisition is stamped with the word "salvage" in red ink. This signifies that there is to be no charge against the department drawing out this material. When a drill has become too short for use in one department it is turned in as "salvage" and reconditioned for use in another department. This is also done with cutters, reamers and grinding wheels. The allotment sheets show where the salvage should be used and each item so salvaged is listed "no charge."

The tool-salvage department keeps in touch daily with the various department foremen, advising them of available salvage tools especially when these are in addition to the tools specified on the allotment sheets. The use of salvage tools so far this year has amounted to $1 per car. This sum represents what the cost would have been had we purchased new tools. The amount of money spent to recondition the tools amounted to 30 per cent of the original cost. This 30 per cent is charged off as expense, and is pro-rated over the entire portion of the plant that is benefited by the use of the tools.

One important factor that has a direct bearing on tool cost is the listing of sources of supply. This list is made up by the methods and standardization department and contains the names of the firms whose tools have given us the best results in actual use over a period of from one to four years.

Selling Machine Tools

BY ENTROPY

Taking the machine tool business of the country as a whole it does not seem likely that the amount of the total domestic sales is at all affected by advertising, salesmen's trips, or any kind of selling campaigns. What does happen is that of the total business available, more goes to the firms that advertise continuously and follow up their inquiries by personal interviews than to the firms that trust to luck that their share of the business will fall into their laps.

However, the purchaser pays for all this. He pays for the privilege of being solicited by a dozen representatives of different machine shops and it all comes in the bill for whatever he does buy. The point of this is that if customers make it expensive for firms to sell them their equipment, they simply add to a burden something which does no one any good. The customer who writes to every firm that advertises engine lathes, saying that he is in the market for one 18 in. x 8 ft. lathe and that he desires full information regarding it, and then asks that a representative be sent to see him, or what is the same thing, strings along the firm so that they think he is a likely prospect, adds to a total that is already bad enough.

There are a few points on which a customer needs information, he needs to know about the design, the workmanship, the materials, and price and delivery. Most advertisements are unenlightening on all these points. They tell us that the design is superior, the workmanship is workmanlike, the materials are the best in the market, and they suggest we write and ask the price, and whether deliveries are being made now or next year. In the old days of advertising when an ad was a permanent thing not changed from year to year, to say nothing of issue to issue, this was all right, but in these days it is possible to say how superior the design is, not merely that the main bearings have now been made a thirty-second of an inch larger than they were in 1910, but tell why the machine is an improvement on all other, or "garden varieties" of machines. Then workmanship can really be described.

For some purposes a lathe made interchangeable by means of fairly liberal tolerances in the sizes of the parts is good enough, but for our shop of course nothing will do but the finest of all hand-fitted work. Interchangability is all very well if we break a part, but we do not intend to break any parts, and we know that a truly high-grade machine must be hand fitted, part by part. Of course we are glad to know that the legs are drilled in jigs so that if the railroad in its anxiety to make quick delivery breaks one we can get another, but we want all the running parts to fit alike so that we can oil up with a fairly liquid oil and not have any shake in the fits. We want to know what the builder thinks are the finest possible materials. Is the main bearing made of cast iron, babbitt, or, if bronze, of what composition? Are the lead and cross-feed screws made of something in particular or of any stock the boy happened to find on the floor?

Of course it is entirely heretical to suggest any one marking the price of a machine tool in plain figures. To be sure the lathe builder travels to and from work in a machine the price of which, f.o.b. Detroit, is $298.00, which price is as well known as the name of the car itself, but if he should mark one of his lathes $984.50, the chances are he would be read out of the Machine Tool Builders' Association. Of course it would be still worse for him to advertise a line of 24-inch lathes and say, "We are now booked up to April. If you want May delivery order now." It might pay, and anything that makes the machine tool business a paying business should be frowned on.

Ideas from Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered and those published are paid for.

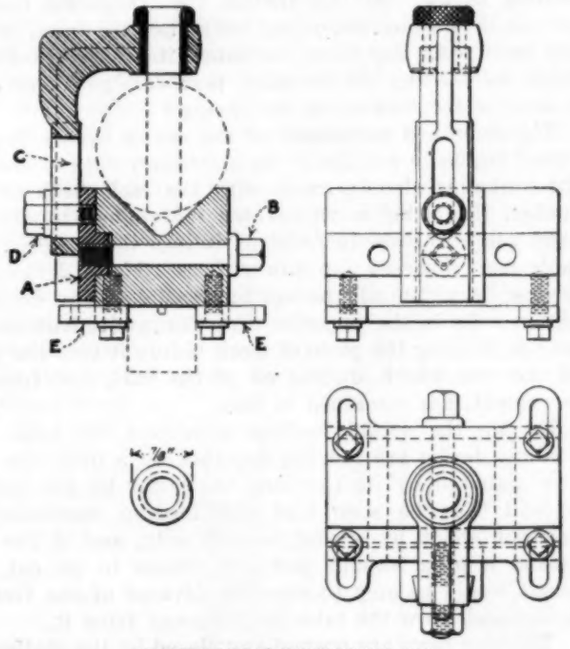
An Adjustable Drill Jig for Round Stock

BY B. R. WICKES

The accompanying drawing shows an adjustable drill jig that is very serviceable in the shop where there is much drilling to be done upon round pieces. By reason of its adjustability it is adaptable to any size of round stock within its range. It will also hold half-rounds, squares or tapers.

The body consists of a V-block, in the side of which is milled a shallow rectangular shaped groove parallel to the V on the upper surface. Part *A* is tongued to fit this groove and is held in position by the long bolt *B*, passing clear through the block. Three (or more if desired) holes through the block permit the bushing bracket to be set at different positions with respect to the length of the block.

At a right angle to the tongue and on the opposite side of part *A* is an open dovetailed slot, fitted to receive the corresponding portion of the bushing bracket *C*, which is clamped to it by means of the shorter bolt *D*. A slot in *C* allows the setting of the bushing bracket at



ADJUSTABLE DRILLING JIG

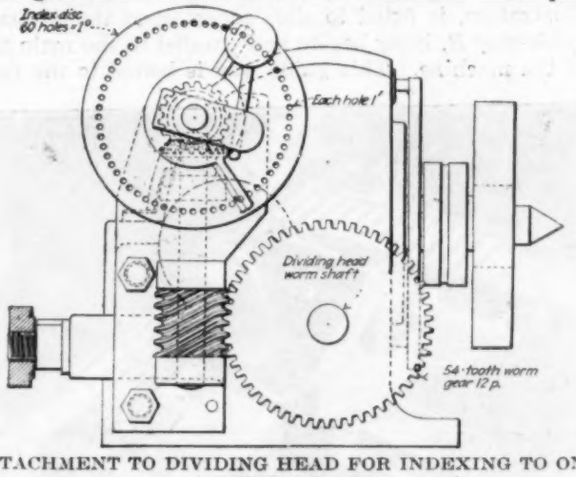
varying heights to accommodate different sizes of work. The bracket may also be turned end for end and the device used the other side up, the work in this case being held by the jaws *E*, which are adjustably attached to the under surface of the block by the small collar head screws. The tops of these screws should be ground off after they are in position and set up tight, as they act as feet upon which the device rests in normal position.

Attachment for Indexing Degrees and Minutes

BY EDWARD J. RANTSCH

The accompanying drawing shows an attachment for universal dividing heads, the purpose of which is to make possible the indexing of degrees and minutes.

Referring to the blueprint, it will be noted that a wormgear has been substituted for the usual index plate



ATTACHMENT TO DIVIDING HEAD FOR INDEXING TO ONE MINUTE OF ARC

and securely fastened to the regular worm shaft. Meshing into this worm gear is a sextuple threaded worm assembled on a bracket and driven by a pair of miter gears. The special index plate contains 60 holes, and is securely fastened to the bracket. The usual index crank handle is used as before, provision having been made to receive it. The complete bracket is held in position by two hex-head capscrews and two dowel pins.

In indexing, one turn of the crank handle equals one degree, and one hole equals one minute. It is necessary to turn the crank handle 360 times to make one revolution of the work. This means that the spindle moves one-ninth as fast as with the original gearing.

Let us say we wish to index the work through an arc of 39 min. As one hole on the plate equals 1 min., we index 39 holes for 39 min. Now take 25 deg. 19 min. As one turn equals 1 deg., we index 25 turns, and add the nineteen holes for the 19 minutes.

One of the jobs that this attachment is useful for is work requiring unequal indexings, such as the graduating of master gages used in checking and inspecting the time-fuse rings of shells. The graduations on the rings all vary, or in other words, are not equally spaced, and the writer well remembers the difficulty experienced in trying to get two master gages to agree.

The attachment can also be used on any tool, jig or fixture work where boring holes to angular measurements is required, as the indexings are so fine that it is possible to get within very close limits.

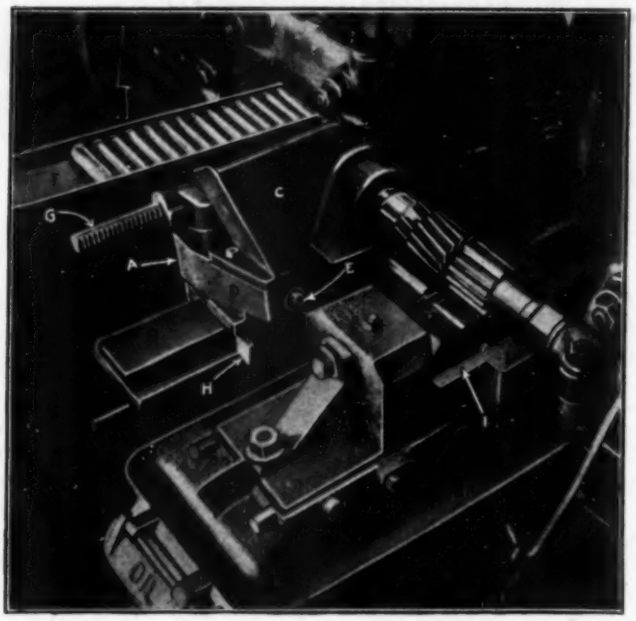
P. & W. Semi-Automatic Milling Machine Becomes Full Automatic

By Ellsworth Sheldon

By an ingenious attachment, a Pratt & Whitney semi-automatic milling machine in the shops of the Lovejoy Tool Co., Springfield, Vt., has been converted into a full-automatic machine, requiring no attention from the operator other than to fill up the hopper occasionally—and no harm done if he should happen to forget it. Mr. Lovejoy himself is sponsor for the device.

The work done by the machine is the flatting off and serrating of one side of round pieces of high-speed steel that are to become the cutting points of the Lovejoy company's inserted-tooth products. The machine is well known to all who have much to do with production work. The attachments that make it full automatic are the hopper and feeding device, and the self-opening and closing vise.

The feeding device, shown at *A* in the accompanying illustration, is fitted to slide freely upon the dovetailed guide-way *B*, lying beside and parallel to the main table of the machine. This guide way is bolted to the frame



AUTOMATIC FEEDING DEVICE ON P. & W. SEMI-AUTOMATIC MILLING MACHINE

of the milling machine and has no movement. The device is normally held against a positive stop in the position shown in the cut by a stiff coil spring; but at certain times in each cycle it moves outward to the end of the guide-way.

The hopper is in two parts. The triangular shaped casting *C* was first devised to hold a number of the pieces to be milled and the cavity was intended to be filled with the work. In the casting *D* there is a cradle just large enough to accommodate one of the pieces which, when lying in the cradle, will be in line with a bushed hole through which it may be pushed endwise out of the device. At *E* may be seen one of the pieces protruding slightly from the bushing; this piece, however, is not in normal position but was pushed part way out to show its location in the photograph.

Because of the tendency of the work pieces to jam and "hang up" in the triangular cavity of the original hopper, the sheet metal part *F* was added, the leg of which extends down into the cavity and closes off a portion of it so that now there is but a single stack of work pieces within the original hopper. The upper part of *F* is sufficiently inclined to cause the round pieces to roll forward against a stop, where the last piece in line rests on top of the vertical stack, ready to follow down as the pieces are successively pushed out from the bottom.

The transverse hole in part *D* passes clear through the cradle, of course, forming the central portion of it. A round plunger, or pusher, slightly smaller in diameter than the work pieces, fills this hole when the device is at rest; but during the feeding movement it is withdrawn by a rack and pinion to allow the lowest piece of work in the stack (that up to this time has been resting upon the pusher) to fall into the cradle. As the device returns to its normal position the pusher advances, driving the work piece before it entirely out of the device and into the jaws of the work holding vise.

The pinion that operates the pusher is inclosed within the device and cannot be seen in the picture. The operating rack may be seen at *G* extending some distance from its guide, through which it is free to slide. The pusher also has rack teeth cut along one side and these two racks cross at a right angle, one slightly above the other. The pinion is long enough so that it is at all times in engagement with both racks.

Rack Has No Movement

The rack *G* is pinned at its inner end to the main frame of the milling machine and has no movement; it is the feeding device that moves. As the machine table is moved back by its cam, a permanent stop attached to one side of the table contacts with the lug *H* on the feeding device. At this instant the transverse hole in part *D* is in exact alignment with the vise jaws, which are open. As the table continues its rearward movement the feeding device must, perforce, go along with it against the tension of the spring.

The rearward movement of the device causes the inclosed pinion to roll along the stationary rack *G* and, as the pinion is also in mesh with the rack teeth of the pusher, the latter is withdrawn far enough to allow a work piece to drop in front of it into the cradle. The table now reverses and moves forward, the device following by virtue of the spring tension. The enclosed pinion rolls in the opposite direction and advances the pusher, driving the piece of work before it into the jaws of the vise which, during all of the back and forward movement, has remained in line.

During the actual feeding movement the table and feeding device are moving together as a unit, the former actuated by its cam and the latter by the spring. It will thus be seen that the feeding movement is brought about by spring tension only, and if for any reason a piece should jam and refuse to go out, the result would be only to stop the advance of the feeding device and allow the table to run away from it.

The vise jaws are opened and closed by the stationary cam *I*, attached to the machine bed at the opposite side of the table. At the rear of the vise there is an eccentric shaft that actuates the movable jaw, and to the end of this shaft is keyed a lever having at its outer end a roll that passes under the inclined surface of the cam *I*. At about the time when the table in its rearward movement has brought the stop into contact with the lug on the feeding device, the roller of the vise-operating lever passes out from under the cam and the jaws are open,

being opened and held so by springs. The table completes its return and again comes forward to this point, during which movement the feeding has been accomplished. Continued movement of the table then closes the vise jaws and carries the work to the cutters.

It is at about this point also that the table changes from slow to fast movement and *vice-versa;* but this has no bearing upon the operation of the device.

As the table continues forward the roll of the vise operating lever passes under the cam *I* and the jaws close. When closed, the pressure comes upon the high point of the eccentric (the position of which is adjustable) which thus acts as a toggle and relieves the cam and lever of the duty of maintaining the grip.

The milling operation is a double one; the two cutters nearest the main bearing of the machine flatting off a side of the round piece in the first position, while the remaining cutter mills the serrations upon a portion of the flatted surface in the second position.

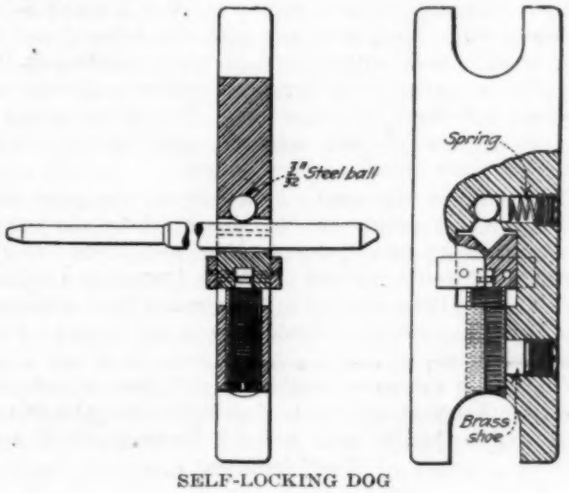
The piece as fed in by the pusher is round; having been previously finished to diameter and length. As the machine goes through its cycle the piece in first position is flatted. At the beginning of the second cycle the incoming piece pushes the already flatted one from first to second position. At the beginning of the third cycle the new piece again pushes the flatted piece forward, and this one in turn ejects the serrated piece from the vise. The machine thus completes one piece at each cycle after the second.

Adjustable Self-Locking Dog for Small Work

By George J. Fallow

Having a large quantity of small pins and piercing punches of different sizes to grind and noting the time lost in dogging them I designed the dog as per sketch and have found it to be a time saver of no small proportion, and well worth the time spent on its construction. The sketch shows the lock to be a $\frac{3}{32}$ in. steel ball with a spring and set screw back of it to hold it in place.

By giving the piece to be ground a slight turn in direction of the spring, it will slide into the dog quite easily, but reverse the motion and it will lock. The more pressure applied the tighter it holds. The V-block is adjusted by the screw in the center and when once set to size is locked by a screw on the side. A brass shoe under the locking screw prevents it from marring the adjusting screw.



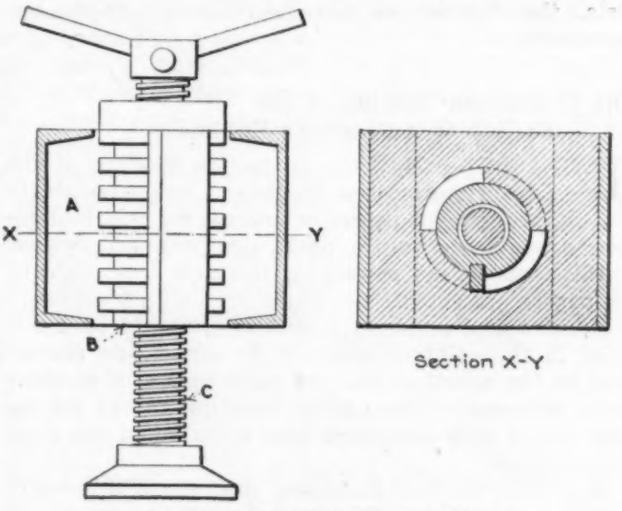
SELF-LOCKING DOG

A Quick Acting Screw Jack

By John S. Watts

At the Wabana Iron Ore Mine, electric shovels are used to load the ore into the mine cars underground. The pile of ore to be loaded is somewhat scattered and requires the moving ahead of the shovel quite frequently. The shovel is mounted on a wheeled truck traveling on rails and there are four jacks, one at each corner, which are screwed down to hold the truck from moving while the shovel is being forced into the pile.

To move the shovel forward involved the screwing up of the jacks some four inches or more to clear the ties,



QUICK ACTING SCREW JACK

and after moving, the four jacks had to be screwed down a similar distance. To shorten the time required to perform this operation, the jack shown in the accompanying sketch was designed. The nut is made in two parts, *A* and *B*, the part *B* having rings turned on its outer surface which fit into corresponding grooves in the hole in *A*. These rings and grooves are rectangular in form, and equally spaced. The rings on part *B* and the lands in part *A* are machined off for ninety degrees around the circumference on two opposite sides, and a key fitted on one side as shown in the sketch.

In use, after slacking the screw *C* enough to just release the load on it, the part *B* is revolved by means of the handles shown through ninety degrees in a counter-clockwise direction. In this position the rings on part *B* are out of mesh with the lands on part *A*, and *B* can now be lifted up the four inches or so required to lift the jack screw clear of the ties, and then revolved back again ninety degrees into mesh where it will stay until the shovel is moved forward into its new position.

After the shovel has been moved, part *B* is revolved again until the rings are clear of the grooves when it will drop until the screw *C* strikes the ground. Another movement of *B* back to its original position and it is locked again ready for the screw *C* to be tightened up. This arrangement eliminates all movement of the screw *C* except that required to merely take up the weight. The function of the key in part *B* is to prevent excess travel in either direction, and also to stop any tendency for part *B* to revolve with part *C*.

To insure that the rings on part *B* will enter the grooves in part *A*, in any position that *B* may take vertically, the rings and lands are beveled off on the entering edges.

Editorial

NO ONE need hesitate for a moment and try to remember statistics about this and that auditorium or ball room in imperial palaces. The largest room in the world is—the room for improvement. It offers an ever lengthening vista, the further we advance therein. It is immeasurable.

The Production Meeting of the Society of Automotive Engineers

THE FIRST exclusively production meeting of the Society of Automotive Engineers, held recently in Detroit, brought out papers of interest not only to automotive engineers but to production men everywhere. In this issue we are publishing abstracts from eight of the papers presented.

Machine tool builders, particularly, should be interested in the point of view of the automobile factory man on the selection, use and maintenance of machine tools, for some of the highest developments in the application of such equipment have occurred in our automobile shops.

A feature of this gathering, and one which might well be adopted by other branches of the machinery industry, was the free interchange of information on problems common to the whole automobile industry. Automobile manufacturing is a young business, run mostly by young men, and apparently free, to a large extent, from the diseases of knowing all there is to know about your own specialty and guarding that knowledge carefully from the rest of the world. As a result of the progressive spirit manifested in opening up their shops and their minds to new ideas, the automobile men have been successful beyond many other manufacturing fields in putting their business on a scientific and economically sound basis.

As an experiment, this meeting was a huge success and will undoubtedly be followed by others like it. We should like to see every branch of the metal trades attempt something of the sort.

Thanksgiving in 1922— A Real Feast

THERE IS a sound basis for a real Thanksgiving all along the line this year. As a consequence we feel moved to comment on the one holiday on which we always bring out an issue of the *American Machinist*.

Looking backward is an interesting procedure if one does not indulge in it too often. At this time we wish only to go back over five Thanksgiving Days. What a world of change has taken place in that short space of time!

In 1918 we celebrated the national feast only a fortnight after the signing of the armistice which brought the World War to an end. A great feeling of relief from anxiety was everywhere but the wiser ones among us were beginning to think of the hard reconstruction days ahead.

A year later we were not far from the crest of the wild wave of inflation that followed the deprivation and self-denial of four years of war. Money was rolling into the pockets of the laborer and the treasury of the company at an unprecedented rate and but few saw the precipice in front of us.

Before the next Thanksgiving Day the bottom dropped out of the market and times were very bad indeed. A glance at the files of the *American Machinist* shows that our editorial page for the Thanksgiving issue was devoted to a denunciation of contract cancellation and other evidences of business demoralization.

By November, 1921, the worst was over and business men were beginning to congratulate themselves that they were still solvent and looking hopefully to the future. The business tide was still at a very low ebb. however, and unemployment was so serious a menace that a conference was called at Washington to consider ways and means of meeting the situation.

And now we have reached another Thanksgiving Day. Some industries have been booming along for months, others are just reaching the stage of prosperity, while even the machinery industry is getting orders that seem almost like those of the proverbial good old days. We may have to skimp a little on coal this winter but unemployment is a thing of the past and wage increases are being dictated by the excess of demand for labor over the available supply.

A labor shortage is a pleasant thing for the worker to contemplate as it means the laying of the unemployment specter which is almost always lurking before his subconscious mind. But it should be even pleasanter for the machinery manufacturer as it means inevitably a quickened interest in labor saving devices of all kinds and a ready market for his products.

Truly this is a better Thanksgiving than we have had in years, with business on a sound basis and the tide of prosperity on the flow, employment for everybody and new markets constantly opening ahead.

May we make the most of our opportunities!

Just Suppose

JUST suppose two men try to sell you a machine for heavy work, that is to say each one tries to sell his own make. And suppose one of them points out that his driving pulley is of larger diameter and will take a wider belt than the other one. You would probably be inclined toward that machine, provided, of course, that they were equal in other points.

Now suppose you need a new furnace for your home and one maker points out that his machine can assimilate much more coal than any other, would you buy that furnace, or would you say: "What I want is a furnace which burns little coal, and gives much heat, especially this coming winter." Wouldn't you say that or something similar?

Oh, yes, a salesman would not call your attention to the fact that a great deal is required to run the thing—at least not when he tries to sell a furnace. Well, but—

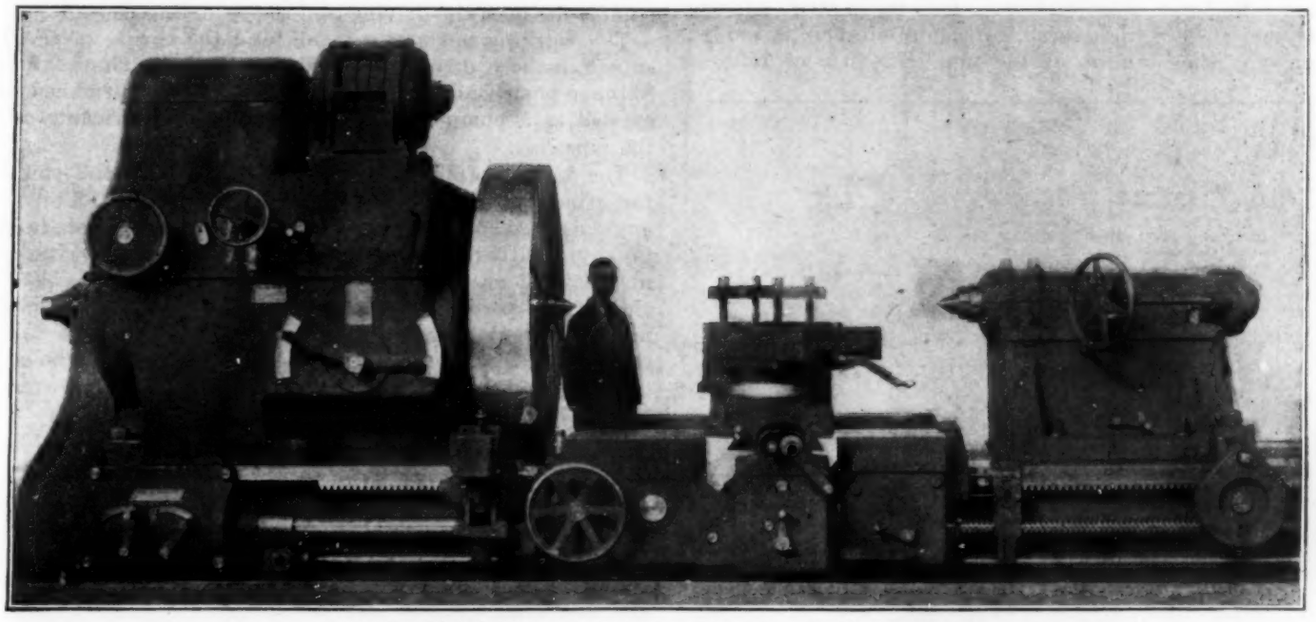
Just suppose.

Shop Equipment News

Niles-Bement-Pond 60-Inch Heavy-Duty Engine Lathe

An engine lathe of 60-in. swing and for heavy duty that has recently been developed by the Niles-Bement-Pond Co., 111 Broadway, New York, N. Y., and built at its Pond Works, Plainfield, N. J., is shown in the accompanying illustration. The machine is fitted with a constant-speed motor of 40 hp., and it has twenty-four faceplate speeds obtained by change gears operated by levers located on the headstock.

When an adjustable-speed direct-current motor is used for driving, the geared speed changes in the head above the joint line are eliminated without reducing the speed range of the faceplate. The motor is then mounted on the head near the faceplate and the drive taken from it at the outer end of the machine. The motor may be started and stopped by a handle mounted on the carriage. When direct-current drive is employed, any faceplate speed within the range of the motor may be obtained by the use of the same handle. A pushbutton on the headstock may be used for "jogging" the driving motor to give quick and easy shifting of the speed-change gears.



NILES-BEMENT-POND 60-INCH HEAVY-DUTY ENGINE LAT

The headstock is heavily constructed and is entirely inclosed, to prevent injury to both the operator and the gearing. All bearings and gears are continuously oiled by means of a pump supplying filtered oil to a reservoir in the upper part of the head, from which it is distributed by pipes. The surplus oil drains into a settling tank in the base of the head, from which it is pumped through a filter back to the reservoir.

The spindle bearings are very large, and on account of the slow speed of rotation, are fitted with oil distributing rings and large oil wells, in addition to the continuous oil supply. The faceplate has four pairs of parallel slots at right angles to permit attachment of faceplate jaws. The tool-steel centers are hardened and ground and fitted with large spanner nuts to aid extraction.

Adjustment of the tail spindle is accomplished through gearing by means of a handwheel located on the side of the tailstock in a position convenient for the operator when placing work between the centers. The upper portion of the tailstock has a cross adjustment operated by a screw for use in turning small tapers. It is clamped to the lower section by heavy bolts independent of those which clamp the tailstock to the bed. The adjustment of the tail spindle is not changed when moving the tailstock on the bed.

In addition to the bolts which clamp the tailstock to the bed, there is a pawl engaging a ratchet so as to brace the tailstock and prevent slipping under very heavy end thrust. The pawl may be lifted out of the ratchet by a handle on the front of the tailstock. The ratchet is made in sections and is easily removable to allow cleaning out chips that may accumulate in the bed.

The tool carriage has lateral, cross and angular power and hand feeds, and also a rapid traverse along the bed operated by a 5-hp. motor. This motor is connected with a drum switch having a spring return to the off position and mounted on the carriage. The control of the driving motor also is obtained through a handle on the carriage. The tool slide is the full width of the bridge and has clamping bolts and straps for securing the cutting tools. Large micrometer collars are fitted on the crossfeed screws.

The apron is of the one-piece type. All shafts have bearings at each end and the gears and bearings are oiled from one reservoir, which is filled from the top of

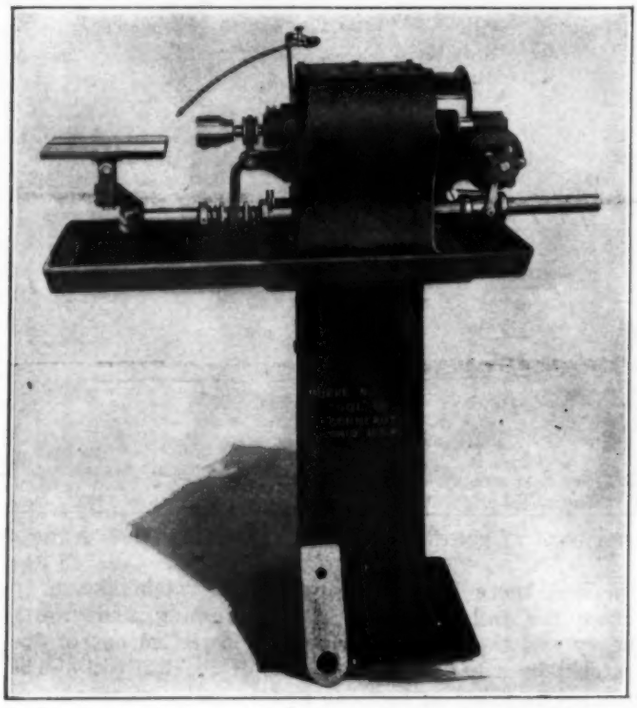
the carriage. The direction of any feed may be changed and started and stopped at the carriage. The levers are conveniently located and are so interlocked that no two feeds can be engaged at the same time.

The thread of the leadscrew is used only for thread cutting, feeds being obtained from a spline in the screw. A quick-change gear box gives four feeds without the necessity of removing gears. Removable change gears can be provided for obtaining any other feeds or threads that are desired. All gears and bearings in the feed box are oiled from a tank providing an ample supply of lubricant.

On lathes with long beds, the lead screw and controller shaft are supported at intervals by bearings which are automatically spaced by the carriage. A steady rest having five jaws with screw adjustment and large wearing surfaces is included in the equipment.

Burke No. 10 Automatic Tapping Machine

The Burke Machine Tool Co., Conneaut, Ohio, has recently put on the market the horizontal-spindle automatic tapping machine that is illustrated herewith. The machine has a capacity from ¼ to ⅝ in. in steel, and can be run at very high speed, so that production is limited only by the stamina of the tap. The use of relieved



BURKE NO. 10 AUTOMATIC TAPPING MACHINE

taps is recommended. It is stated that the production does not depend on the experience of the operator, as the automatic features of the machine give rapid production even with unskilled operators.

The machine is driven by a constant-speed belt, and may be run directly from the lineshaft. If several different sizes of taps are to be used in it, a countershaft giving three speeds can be provided.

The chief feature of the machine is that it is equipped with a power feed and an automatic reverse. It is not necessary to depend on the pressure on the tap to make the machine drive and reverse, such as with hand-operated machines. Since the tap runs perfectly free, the tendency to cut oversize is eliminated, and an accurate thread can be cut.

It is only necessary for the operator to place the work on the machine and push it against the tap until the latter has entered the hole. The power feed then engages and drives the tap until the thread is completed. At this point, the spindle automatically reverses and backs the tap out at twice the forward speed. Since the operator does not need to press the work against the tap during its forward motion and to pull it outward during the reverse motion, his hands are free to select another piece for the next cut. The mechanical feed gives a more uniform and rapid production than hand feed.

The machine drives through a friction mechanism governed by the automatic feed, which is in turn controlled by another friction device. By this arrangement, the machine may be set for very sensitive operation, so that it will slip before breaking taps of small size. It can also be adjusted to pull large coarse-thread taps. The machine is driven through the frictions on both the forward and the reverse motions. These frictions are of taper cone design and the ring keyed on the spindle fits both the driving and the reversing cones.

The working parts run in oil, and the thrust of the spindle in both directions is taken on ball bearings. A Skinner positive-drive tap chuck is regularly furnished, as well as a pump and tank for supplying lubricant to the taps.

The table is fully universal and fitted with a T-slot for attaching jigs, so that holes can be tapped at any angle desired in the work. The table is fed toward the tap by positive power feed. A faceplate also is furnished to fit on the drawbar in place of the table. The side of the plate opposite the front of the machine is planed so that jigs or fixtures may be attached to it, the tap entering the work after passing through a hole in the plate. In this way, parts can be tapped that are larger than can be handled on the universal table.

Baker Ball-Bearing Air Compressors

The Baker-Hansen Manufacturing Co., 1900 Park St., Alameda, Calif., has recently added to its line of ball-bearing air compressors. Larger sizes in both duplex and two-stage machines are now made, and compressors can be furnished with capacities from 5 to 50 cu.ft. of air per minute.

In Fig. 1 is shown a duplex compressor fitted with a glass cover on the crankcase so that the arrangement of the ball bearings can be seen. The machine is constructed similarly to the two-stage type, except that both cylinders are of the same diameter. Both pistons are made integral with a bar that passes from one cylinder to the other. A small connecting link is pivoted at one end on one piston, and run on the ball-bearing crank at the other end. Thus all rotating movement is carried on ball bearings, so that friction is greatly reduced. The bearings are easily accessible for replacement when they have become badly worn.

A ring valve with an automatically operated diaphragm is employed. This valve requires a smaller space than a poppet valve, and thus reduces the amount of piston clearance. An unloader is provided so that the machine can be started without load, and the load gradually put on. A pressure switch of the two-pole type having a one-piece diaphragm is used. This switch

can be sealed so that it operates at any desired pressure to stop the compressor automatically when the pressure has been built up to the predetermined point.

The cylinders are cooled by water circulated from the hoppers by means of the thermo-siphon systen.. Each cylinder has a strainer to prevent dust from entering.

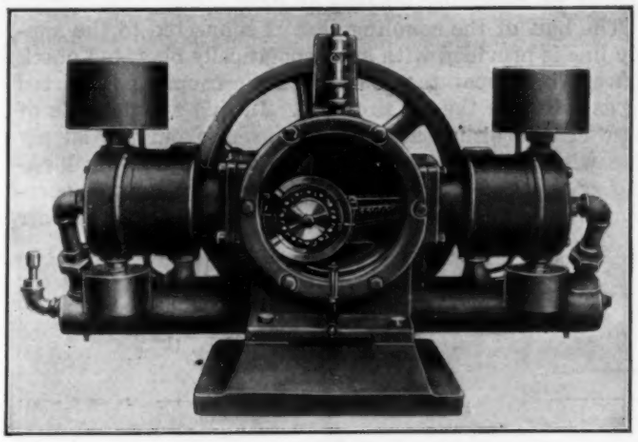


FIG. 1—BAKER DUPLEX BALL-BEARING AIR COMPRESSOR

The receivers are of welded and riveted steel. The compressor and the motor are mounted on cast-iron bases bolted to channel iron and placed on top of the tank, as shown in Fig. 2. Belt drive is employed. The arrangement is such that a minimum floor space is required for the installation.

The latter illustration shows a two-stage compressor having a capacity of 25 cu.ft. of air per minute and working at pressures between 140 and 175 lb. The air is first compressed in the large cylinder, then passed to the copper inter-cooler, and finally compressed in the small high-pressure cylinder. Machines of this type can be furnished for operation by either 1 or 5 hp. motors,

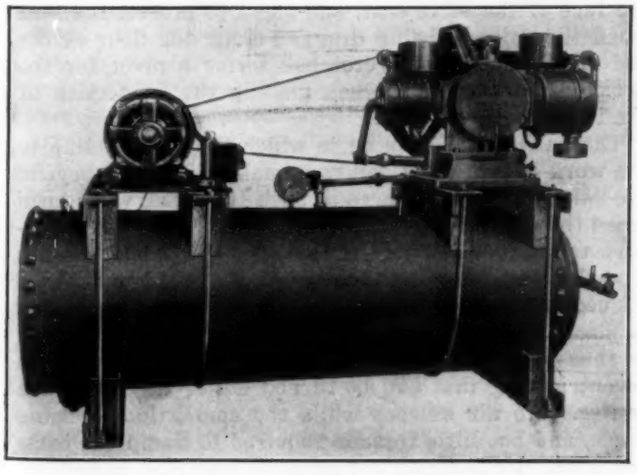


FIG. 2—BAKER TWO-STAGE BALL-BEARING AIR COMPRESSOR

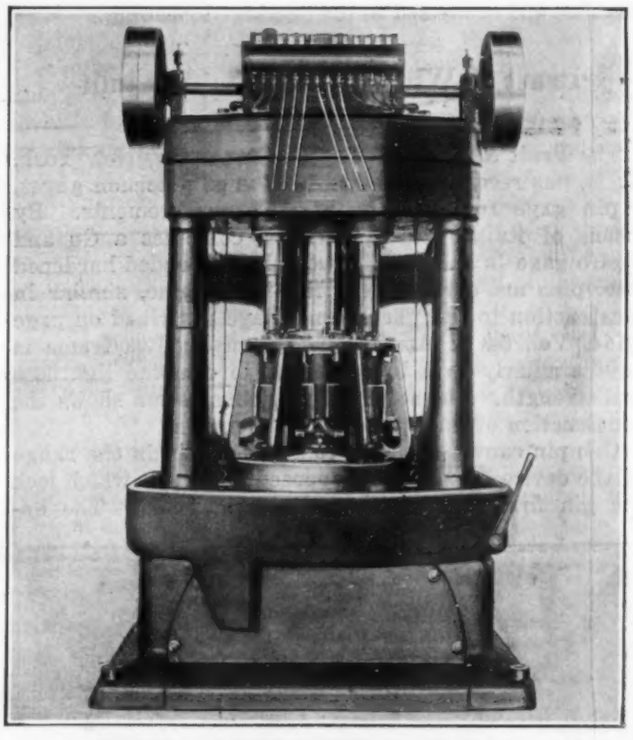
and tanks of different sizes can be provided, according to the nature of the work.

The duplex machine is provided for working pressure of 120 to 150 lb. per square inch for motors of 3, 5, 7½, 10 and 15 hp., depending upon the output required. A variety of sizes of tanks and motors can be coupled to three standard sizes of compressor proper to suit the equipment to varying conditions.

Manufacturers' Consulting Engineers Multiple-Spindle Cylinder Boring Machine

A multiple-spindle machine for boring gas-engine cylinders and finishing the head at one end of the bore has recently been developed by the Manufacturers' Consulting Engineers, McCarthy Building, Syracuse, N. Y. The machine is shown in the accompanying illustration equipped for boring air-cooled automotive-engine cylinders, although it can also be employed for boring cylinders cast *en bloc*.

There are five spindles in the machine; they do not move axially, but have only rotary motion. The work is mounted in a rotating fixture having six positions, five working positions and one for loading. The loading and unloading are done while the cuts are being taken,



MULTIPLE-SPINDLE CYLINDER BORING MACHINE

so that the only lost time is that required for indexing the fixture. Three separate cuts are taken for boring, and two for finishing the head of the cylinder, all being performed simultaneously.

The work holder and work are fed upward to the cutting tools by a cam which makes it possible to obtain a quick return, a quick approach, a uniform boring speed, a reduction in feed for machining the head of the cylinder, and a dwell for the final finishing of the head. It is stated that the time required for the complete cycle of the machine when boring a cylinder 3¼ in. in diameter and 9$\frac{5}{32}$ in. long is 1½ min. Where cylinders are machined in blocks having removable heads, the machining time is reduced.

Unusual rigidity is claimed for the machine, which feature gives accuracy of workmanship. This rigidity is obtained through the use of a large diameter pilot that is integral with the head of the machine and passes through the ram on which the rotating fixture is mounted. The parts are heavily constructed throughout.

The machine is semi-automatic, the only duties of the operator being loading and unloading the work while

the machine is in operation, indexing the fixture when the machine comes to rest automatically at the end of its quick return, and engaging the clutch after the fixture has been indexed.

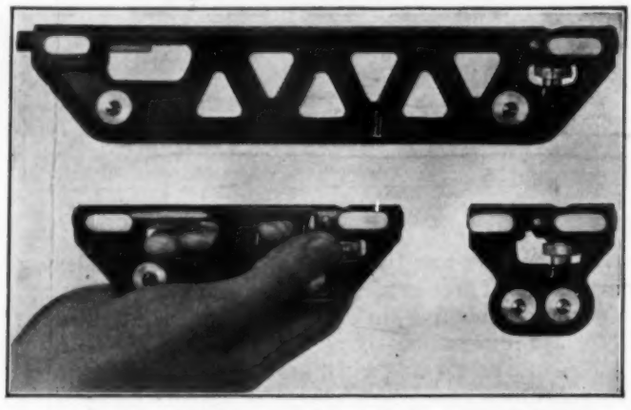
Coolant is employed to keep the cylinder at an approximately constant temperature throughout the cut, so that no distortion due to heating occurs. The coolant is pumped through the spindles and discharged adjacent to the cutting tools on the surface to be machined. It serves to wash away the chips as soon as they are formed. Passing the coolant through the spindles keeps them and the bearings at a constant temperature.

The machine is of considerable size. Its height from the floor to the top of the pulley is 8 ft. 2 in., and the base is about 5 ft. square. The machine is belt driven, with the driving pulley on top of the spindle head. A central oiling reservoir is mounted at the top of the machine and connected to the bearings by tubing.

Pratt & Whitney Adjustable Limit Pin Gage

The Pratt & Whitney Co., 111 Broadway, New York, N. Y., has recently added to its line of precision gages, a pin gage for making internal measurements. By means of its adjustable limits it combines a Go and No-Go gage in one unit. Two spherical-ended hardened steel pins are carried in a cast-iron frame, similar in construction to the "Trusform" gage described on page 1,144, Vol. 54 of *American Machinist*. The frame is built similarly to a bridge truss to combine lightness and strength. The accompanying illustration shows the construction of gages of different lengths.

One pin can be adjusted to any size within the range of the device by means of opposed setscrews which lock the pin firmly in position when tightened. The opposite pin works between two stops, one of which is adjustable to give limits from 0.001 to 0.025 in. The pin can be quickly moved by the thumb and finger of the hand in which the gage is held, the position being shown by the view on the left at the bottom of the illustration. The fingers can be turned in one direction to bring the pin to the Go position, and in the other direction to bring the pin to the adjustable stop for the No-Go size.



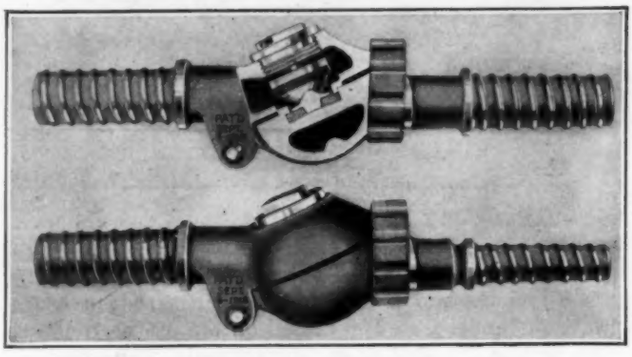
PRATT & WHITNEY ADJUSTABLE LIMIT PIN GAGES

The adjustment may be sealed to prevent tampering with the measurements. The setting can be tested at any time and change made to compensate for wear. Four removable brass disks provide space for marking sizes and other necessary information.

Robinson Automatic Air-Hose Coupling

An air-hose coupling recently placed on the market by the Robinson Machine Co., 39 Eighth St., Muskegon, Mich., is shown in both exterior and sectional views in the accompanying illustration. The purpose of the coupling is to prevent loss of air in the supply line when adding or removing lengths of hose.

The half of the coupling that is connected to the supply line is provided with an automatically operated check valve, which operates as soon as the coupling is parted so as to retain the air pressure. In this way lengths of hose can be either added or removed from the supply line without loss of air, a feature which prevents kinking of the hose. Neither is it necessary for the operator to go continually to the pipe line to turn the air on and off when it is desired to change tools or uncouple the hose. Tools may be changed by simply uncoupling and coupling at the work, so that the time of the operator is saved.



ROBINSON AUTOMATIC AIR-HOSE COUPLING

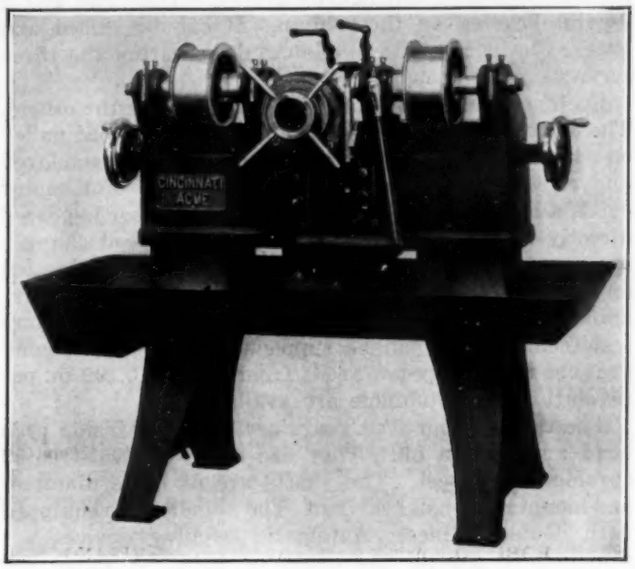
The check valve consists of a brass stem having a leather disk valve facing that can be easily replaced. The valve stem is centered in a reamed hole in the valve cap. Two projections with a crossbar extend beyond the face of the valve seat, and serve to protect the seat when the valve is being dragged along the floor at the end of the hose. This crossbar forms a pivot for the hook on the hose half when making the connection of the two members.

The half of the coupling to which the hose leading to the work is connected has two small projections beyond the valve face, which serve to push the check valve open when the connection is being made, thus admitting pressure to the new section of the line. This half carries a gasket to give a tight connection. When making a connection the hook on the hose half of the coupling is placed under the pin on the line half. The coupling is then pushed together and clamped by means of an eccentric ring that can be turned either way from the center. No air escapes while the connection is being made, and but little force is required to clamp the parts together. Unclamping can be performed just as readily. The air that escapes during this operation is from the hose on the work side, not from the supply line.

The hose shank halves are furnished with "Positive Grip" hose clamps for holding the hose tightly to the coupling. When desired for pipe lines, the line half of the coupling can be equipped with a threaded nipple. The coupling is made interchangeable in $\frac{1}{2}$ and $\frac{3}{4}$ in. pipe and hose sizes. The body is of malleable iron, and is not subject to corrosion under ordinary conditions. Oil has no effect on the coupling, as the gasket maintains a tight connection even when oil is present.

Cincinnati Acme Duplex Valve Milling Machine

The Acme Machine Tool Co., Cincinnati, Ohio, has recently developed the hand milling machine shown in the accompanying illustration. The machine is equipped with two opposed spindles and is especially adapted for milling straight and tapered squares or flats, such as are



CINCINNATI ACME DUPLEX VALVE MILLING MACHINE

necessary to give the grip for the wrench on the bodies of valves. Either steel or brass can be cut, and the production is limited only by the speed at which the milling cutters can remove the stock, since changing the work can be accomplished very rapidly.

The two spindles are high-carbon steel forgings, and run in bronze bearings. They are independently driven from a plain countershaft, and when necessary, two speeds can be provided. The ends of the spindles have No. 9 B.&S. tapered holes to receive the milling cutters, and they are also provided with slots in the faces to receive the driving tangs of the cutters. The heads are arranged to swivel, so that either straight or tapered surfaces can be machined. They are mounted on slides which have longitudinal adjustment along the bed by means of the handwheels at each end. Micrometer dials aid in setting the slides, so that accurate adjustment can be obtained.

The bed upon which the heads are mounted carries at the front a vertical slide for the work-holding fixture. Adjustable gibs are provided to compensate for wear. The work-holding fixture is opened and closed by the four-pronged handle. It is similar to an automatic spring collet chuck, and the work is inserted from the front. A slight rotating motion of the handle to the right clamps the work, while a partial turn to the left opens the chuck. After the work has been clamped, the entire chuck is free to revolve. The chuck is arranged for indexing to four positions, and it can be clamped in each by a hardened and ground locking bolt.

The work-holding slide is given its vertical movement by means of the long lever connected to it by links. Motion of the lever causes the work to pass between the milling cutters, thus milling two sides of it simultaneously. As the slide moves downward after the cut is finished, the locking bolt is withdrawn from the work-holding fixture automatically, so that the operator may revolve the chuck with his left hand. In his right hand, the operator constantly holds the operating lever, so that the work can be very quickly fed again between the cutters. The vertical slide is counterbalanced to move freely in either direction.

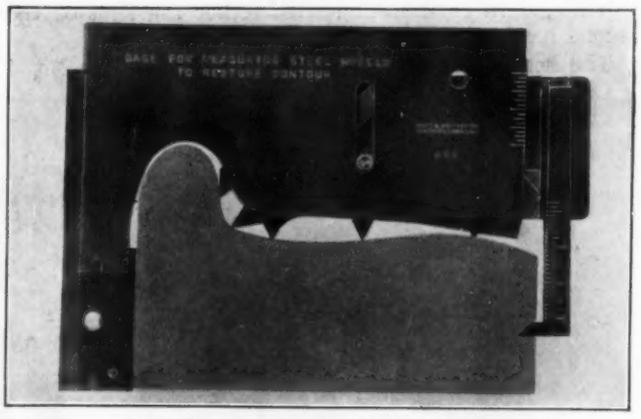
On the back of the bed between the heads there is a small horizontal slide on which is mounted an adjustable stop. The work is brought against this stop, so that all pieces are held alike and the square is machined to the same length on each. A pump to supply coolant to the cutters is also located on the rear of the machine. A large drip pan having a sump collects the coolant after it has passed over the work.

Pratt & Whitney A.R.A. Wheel-Tread Gage

A gage for measuring steel railway wheels when about to restore the proper contour to the tread has recently been placed on the market by the Pratt & Whitney Co., 111 Broadway, New York, N. Y. The gage, which is shown in the illustration herewith, is designated as the A.R.A., since it conforms to the standards and practice recommended by the American Railway Association. It serves to give a direct reading of the amount of service metal still available on used steel or steel-tired wheels, so that this amount may be taken as a basis for billing foreign roads for wheel replacements according to the interchange rules.

The gage indicates the amount of metal that will remain after turning, so that it can be determined in advance whether a worn wheel is worth re-turning to obtain the standard contour. The measurement can be obtained both before and after turning.

In the illustration, the gage is shown applied to a worn tread. The face on the left is held in contact with the wheel, the central pointer is put in contact with the



P. & W. A.R.A. WHEEL-TREAD GAGE

tread, and the hook on the bar at the right is placed in the groove provided in the wheel to indicate the limit of wear. The four sliding pointers are next brought in contact with the wheel and flange. The gage can then be removed for reading.

The sliding front plate is moved downward until its lower edge coincides with the lowest point of the four sliding pointers. The scale on the right of the body of the instrument indicates the amount of metal that must be removed in order to restore the standard contour. The scale on the small bar projecting at the right shows the amount of service metal that will remain after the contour has been restored. The contour may be observed at several points on the circumference of a wheel, so that the maximum wear may be ascertained.

Colburn Special Gang Drilling Machine

A special gang drilling machine having longitudinal movement for one of the heads has recently been placed on the market by the Consolidated Machine Tool Corporation of America, 17 East 42nd St., New York, N. Y., the machine being built at the Colburn Machine Tool Plant, Cleveland, Ohio. The general arrangement of the parts of the machine, as regards the four-spindle column and table, is similar to that in the Colburn gang drilling machine described on page 1,051, Vol. 46 of *American Machinist*. The difference is in fact that there are only two heads permanently mounted on the left side of the column with a fixed center distance between them. The third head is mounted on the right side of the machine on a plate attached to the column and having finished ways.

The movable head has an adjustment of 27 in., and is moved by means of a screw and capstan handle. Provision is made for clamping the head securely in the desired position. The minimum center distance between the adjustable spindle and the nearest fixed spindle is 27 in., and the maximum distance 54 in. The total range that can be obtained by the machine between spindle centers is 27 to 81 inches.

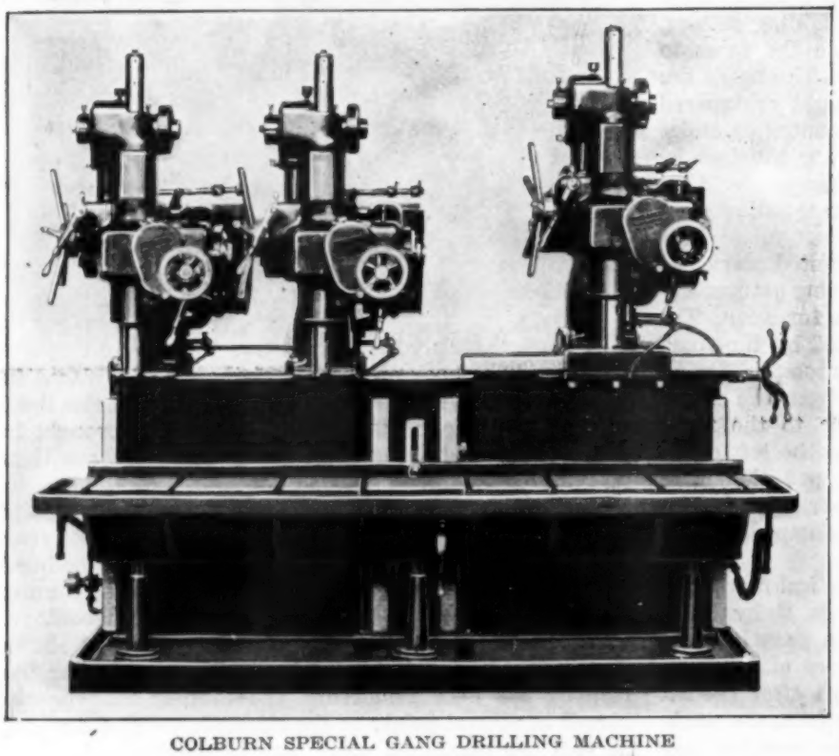
A machine having the same column and table, but with only two heads, can be arranged in the same manner. One head is fixed at the left end of the column, and the other head is movable from the right end over to the first head.

It is easily possible to convert the machine into the regular four-spindle machine with 27 in. fixed center distances between the spindles. The movable head is moved to the left end of its travel, and a fourth head secured to the plate on the right-hand end of the column. By removing the right-hand head, adjustment of the center distance can again be obtained by means of the third head in combination with either the first or the second head on the left.

The heads illustrated are those of the regular No. 4 drilling machine, having a capacity in steel of 2 in., although either the smaller size No. 2 or the larger size No. 6 machine, such as described on page 899, Vol. 55 of *American Machinist*, can be arranged with this mounting. The distance between the center of the spindle and the base of the column is 12½ in., and the machine is rated at 24-in. swing. Supporting screws are provided under the center and ends of the table, and both the table and column are heavily ribbed. The table has a 3-point bearing on the column. It can be raised and lowered by means of a single crank operating the three screws simultaneously.

Each head can be operated independently of the others. The drive is ordinarily by belt to a constant-speed pulley on each head, although a countershaft may be employed and attached to the rear of the machine. For motor drive, a ball-bearing countershaft near the floor is geared directly to the motor. Two mechanical speed changes are provided, although removable change gears located on the left side of each head may be used to furnish fifty spindle speeds from 40 to 500 r.p.m. The two mechanical feed changes can be supplemented by transposing gears so that thirty-two feeds from 0.006 to 0.109 in. per revolution of the spindle are available.

The driving and feed gears are mounted inside each head and run in oil. They are made of heat-treated chrome-nickel steel. The shafts are of large diameter and mounted on ball bearings. The spindles are equipped with double splines. Automatic tripping devices are provided to control the depth of hole. A pump for coolant can be furnished, with piping to bring the coolant directly to the point of the drill.



COLBURN SPECIAL GANG DRILLING MACHINE

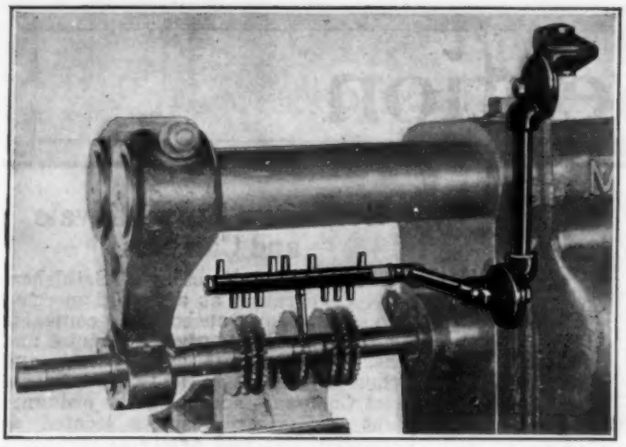
Borgeson "Multi-Production" Lubricator

The "Multi-Production" lubricator shown in the accompanying illustration is a recent product of the Borgeson Tool & Machine Co., Inc., 501 East Water St., Syracuse, N. Y. The lubricator is an attachment for lathes, milling machines and other machine tools, and it serves for directing and distributing the cooling compound to the tools and work. It is equipped with a number of nozzles, so that a flood of coolant can be brought to the position where it is needed to cool the tools and enable continuous production.

The nozzles are mounted on a slotted distributing tube, and are held in position by the tension of a spring. By turning a nozzle on the tube, the nozzle can be brought into position opposite the slot, or it can be turned away from the slot when it need not be used. Since the slots registering with the nozzles are elongated, a considerable range of adjustment is possible for each nozzle in its open position.

The attachment plug by which the coolant is brought to the distributing tube is threaded, and can be located at either the end or the middle of the distributing tube. Standard pipe sizes are employed for the threads, except that a special thread to fit Jones & Lamson machines can be provided.

The distributing tubes can be attached directly to the coolant piping



BORGESON "MULTI-PRODUCTION" LUBRICATOR ON MILLING MACHINE

that is furnished on the machine. Where swivel joints are required, an arrangement such as shown on the milling machine in the illustration can be employed. These swivel joints are made either single or double and allow the distributor to be swung into any position. The joints have large ground friction surfaces and do not leak or allow the nozzles to jar from position when the machine is in use.

From six to twenty nozzles can be furnished on the distributing tube, with a ¼-in. pipe thread connection. Spouts 2½, 3½ and 4½ in. long for attachment to the nozzles can be furnished from stock, and special lengths and shapes can be supplied on order.

Changes in Barker Wrenchless Chuck

The Thomas Elevator Co., 22 S. Hoyne Ave., Chicago, Ill., manufacturer of the Barker wrenchless chuck and drilling machine vise, has recently made several changes in the design of the chuck, which was originally described on page 881, Vol. 42 of *American Machinist*. The cam mechanism has been redesigned so as to obtain greater strength and a greater travel of the jaws, which makes it possible to handle a wider range of irregular work than heretofore.

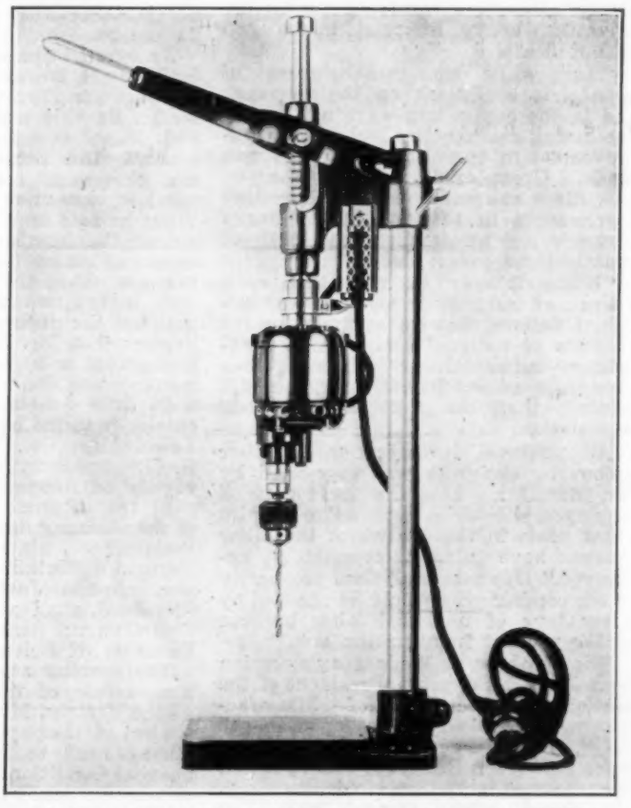
In the smaller sizes of the chuck, a box cam eliminates the necessity for the use of trunnion arms, and in the larger sizes, the arms have been redesigned to obtain greater strength and a wider range of movement. These changes make it possible to apply a large leverage without injuring the chuck. At the top of the accompanying illustration is shown a three-jaw lathe chuck, while a two-jaw drilling machine vise is shown at the bottom.

BARKER WRENCHLESS CHUCK AND DRILLING MACHINE VISE MADE BY THOMAS ELEVATOR CO.

Jones Automatic Sensitive Bench Drilling Machine

A small electric-driven sensitive drilling machine for use on a bench is shown in the accompanying illustration. The machine has a capacity for drilling holes up to ¼ in. in diameter in steel, and it has recently been placed on the market by Joseph W. Jones, 29 West 35th St., New York, N. Y.

The principal feature of the machine is that it is equipped with a device for automatically starting and stopping the motor as the handle is lowered and raised.



JONES AUTOMATIC SENSITIVE DRILLING MACHINE

The motor and the drill do not revolve when the handle is in the raised position and no work is being done. Electric current is saved in this way, and wear is reduced on the parts, since they do not run during the time in which the operator is changing the work underneath the spindle.

The motor drives the spindle through gears, and is operated on current taken from a convenient lighting circuit. The whole installation is very easily portable. The machine is particularly suitable for manufacturing purposes, where light drilling operations are required. The base is 7½ x 6 in. in size, and the column 20 in. high. The net weight is only 18 pounds.

News Section

National Founders Hold 26th Annual Convention

The responsibilities of employers to their employes, with particular emphasis upon the thought that an honest return from labor is predicated squarely upon the giving to labor of honest treatment, was the subject of the annual report of William H. Barr, president of the National Founders' Association, delivered last week at the twenty-sixth annual convention of the association at the Astor Hotel, New York City. Mr. Barr said, in part:

"We have passed through a year of industrial readjustment and conflict, the upward progress of which is complicated; not only by social chaos throughout the world, but also by two national utility calamities involving public deprivation, heavy financial losses and violent death.

"And while the establishment of open shop conditions on the railroads and in the coal mines were not wholly successful, nevertheless, substantial improvement in operating conditions was made. Great credit is due to many executives and mine operators for their fearlessness in refusing, under heavy pressure, to waver from the path of conscientious public duty.

"While it may be true that each branch of industry is more or less selfish, I believe that its attitude toward subjects of national concern no organization—industrial or otherwise—has ever been guided by stronger patriotic motives than the National Founders' Association.

An unbiased investigation of labor unions by Congress was suggested by Mr. Barr. He said the treatment of employes should be such as to inspire "that pride in the job which the labor unions have almost completely destroyed." He predicted that prosperity in the coming year would be checked by a shortage of unskilled labor because of the present immigration law.

The speakers at Wednesday's session were John E. Edgerton, President of the National Association of Manufacturers, who talked on the "open shop;" L. F. Loree, President of the Delaware & Hudson Railroad, who spoke on the railroad situation, and Dr. J. J. Moorehead, whose subject was "The Physician in Industry."

The feature of Thursday's session, Nov. 23, was the talk on "Improved Foundry Practice," by D. R. Wilson, vice-president of the Wilson Foundry and Machine Co., Pontiac, Mich. Mr. Wilson's paper was supplemented by a detailed lantern slide talk by H. M. Lane, foundry expert of the Wilson Co., describing in an instructive manner the operations, processes and methods employed in the Pontiac foundry in securing large scale production.

Colonel Samuel Harden Church, President of the Carnegie Institute, Pittsburgh, was the speaker at the annual dinner. At the final session William H. Barr was re-elected president of the association for the ensuing year and Chas. L. Taylor, of the Taylor & Fenn Co., Hartford, Conn., was elected vice-president.

The attendance upon the convention was one of the chief features, more than fifty per cent of the entire membership being present.

Annual Meeting of Taylor Society

The growing interest in scientific sales and production management was evident last week in the large attendance of keenly interested executives from many lines of industry upon the sessions of the annual meeting of the Taylor Society which held a three-day convention at the United Engineering Societies Building, Nov. 22, 23 and 24.

An excellent paper was that delivered by Percy S. Brown, Works Manager of the Corona Typewriter Co., Groton, N. Y. Its title was "The Organization and Management of a Medium-Sized Plant." The presentation covered all the phases of management, and the speaker was not sparing in detail. What he said aroused great enthusiasm among the members of the large audience and called forth considerable discussion. That the criticism was in no way destructive was evidence of the value of the paper and the belief of his hearers that Mr. Brown's company has formulated a highly efficient management system and is conducting its plant with little avoidable waste. The discussion was led by L. H. Ballou of the Lewis Mfg. Co., Walpole, Mass., and R. H. Landsburg, Horton School, University of Pennsylvania.

In the afternoon Harry B. Horwitz of the planning department of Harry A. Wembridge, statistical division and Herman J. Hutkin of the methods division of the Joseph and Feiss Co., Cleveland, read a paper on Statistical Compilation: Some of its Uses as a Function of Scientific Management.

The evening session was marked by the address of the managing director of the Society, Mr. H. S. Person. The subject of the paper was "Shaping Your Management to Meet Developing Industrial Conditions." The paper was an exhaustive study of present day economic changes with a critical estimate of the management methods which have obtained in industry in the past few years. Mr. Person pointed out the great value to industry to be gained by research and study of the economics of raw material and price movements. He concluded with a forecast that the successful sales or production manager of the next ten years will be one who is a keen annalist of markets and methods rather than the so-called "go-getter" type in evidence in recent years.

The sessions of Friday, Nov. 24 were given over to papers by W. W. Duncan of the Hood Rubber Co.; Ernest E. Brooks of the Dennison Co.; and Philip J. Reilly, associate director of the Retail Research Association.

Bethlehem Buys Midvale and Cambria

The board of directors of Bethlehem Steel Corporation at a special meeting held yesterday authorized contracts for the purchase of the plants and other assets of Midvale Steel and Ordnance Company and of Cambria Steel Company, accepting the ordnance plant and other business located at Nicetown, Pa., and assets appurtenant thereto.

In payment for the properties to be acquired, Bethlehem Steel Corporation, besides providing for the assumption of the bonds and other indebtedness of the Midvale and Cambria companies (excepting current liabilities appurtenant to the operation of the Nicetown plant), will issue about $97,650,000, par value, of the Bethlehem common stock, of which $95,000,000, par value, will go to the Midvale company for distribution on dissolution to its stockholders, and the balance to the holders of the stock of Cambria not held by Midvale.

Further Decline in Structural Sales

A marked seasonal decline in the sales of fabricated structural steel in October is announced by the Department of Commerce from reports made to the Bureau of the Census. October sales amounted to 54.9 per cent of shop capacity, compared with 61.6 per cent in September.

Reports received from 140 identical firms from April through October, with a shop capacity of 221,790 tons per month, show the following actual tonnages booked each month and the percentage of shop capacity represented by these bookings. A revision of these capacities in accordance with a uniform standard is now being undertaken by the Bureau of the Census.

	Tonnage Booked	Per Cent of Capacity
April	191,805	86.5
May	172,260	77.7
June	153,278	69.1
July	141,907	64.0
August	143,515	64.7
September	136,587	61.6
October	121,763	54.9

German Activity in Russia

The well-known Wolf concern of Cologne, one of the largest German concerns in the iron and steel industry, has just formed a new company for the sale of iron, steel, machinery, etc., in Russia. The new company has the right to import these products into Russia, independent of the Russian Foreign Trade Commission. The Wolf concern has placed the amount of 750,000 pounds sterling to the disposal of the Russian Government and promised the further payment of 500,000 pounds sterling. Both sums are to be used in connection with the business of the new company. Branch offices and depots will be opened in a number of the larger Russian cities.

The Business Barometer

This Week's Outlook in Commerce, Finance, Agriculture and Industry Based on Current Developments

BY THEODORE H. PRICE
Editor, *Commerce and Finance*, New York

(Copyright, Theodore H. Price Publishing Corporation, 16 Exchange Place, New York)

HERE are the more important items in the Farm Bloc program as announced by its titular leader, Senator Capper, as Congress convened:

"A complete rural credit organization.

"A reduction in freight rates.

"A re-establishment of state control over intra-state railway traffic.

"A better marketing system.

"The delivery of the Muscle Shoals project to Henry Ford.

"An income tax on corporate surpluses and stock dividends.

"A constitutional amendment prohibiting tax exempt securities."

Other congressmen within and without the Farm Bloc are demanding that a Bonus Bill which will cost no one knows how much shall be passed, and if necessary repassed over a possible veto, and in his speech urging a ship subsidy that will call for from 20 to 50 million dollars a year the President said that the Administration would lend a "willing ear" to any measures that will mitigate the distress of the farmer who is "the chief sufferer from the cruel readjustments which follow war's inflation."

In thus summarizing what is asked of Congress it is not intended to criticize or oppose any of the proposals made. They are all debatable. Each one has the backing of an important portion of the body politic and the demand for lower freight rates will certainly be very popular with every one but the railroads.

But it is also to be observed that in its entirety the program is avowedly agrarian and contemplates a heavy increase in the taxes that are directly paid by invested wealth. Therefore it is not surprising that stocks and bonds have declined. The railroad shares have been especially weak, upon the theory that there might be an early reduction in freight rates, but the stocks of the forty odd big corporations that have recently declared stock dividends have also dropped as the recipients of these dividends have been turning them into cash and buying tax exempt bonds in an effort to prepare for the deluge of new taxes that is anticipated.

But the depreciation that has taken place since Sept. 25, when I first called attention to the change of sentiment, is not primarily due to the selling of any particular group or individuals. Capital, which was growing cautious as the election approached, has been seriously alarmed by the size of the radical vote cast, and the epidemic of fear now prevalent will probably run its course. It is futile to point out that the old Congress now in session will expire by limitation on the 4th of March. That it is unlikely that it will pass any legislation of importance except the appropriation bills. That the newly elected Congress cannot meet before December, 1923, unless the President calls a special session, which is unlikely, and that we probably have a year of comparative political tranquility ahead of us.

All this is forgotten or ignored. But when the wave of pessimism and fear that is now sweeping the investment market has subsided it will probably be found that prices have been carried too low and that the time to buy is when, as at present, most people are eager to sell. This is why I am now disposed to suggest that those who have common sense and money should commence looking for bargains in the confident belief that the people of this country will, in the future, as in the past, find a way to avoid being ruined by fool legislation.

The commodity markets and business generally have not as yet felt the stock market depression, nor is it logical that they should, for most of the proposals by which investors have been scared are intended to benefit the farmer and the wage earner.

The scarcity of labor is becoming acute. In the country as well as in the cities there is a job at good pay for every one who wants to work. One result of this is sustained activity in the retail and jobbing trades, but there has been no speculation and the buying is still from hand to mouth.

The railroad congestion is somewhat relieved. The Federal Reserve statement shows a substantial contraction of credit, a gain of $15,000,000 in gold and a higher reserve ratio, but the money market is no lower.

The production of coal is now on a scale which assures an adequate though not a superabundant supply for the winter. Both iron and steel are somewhat lower as the demand for the latter is a little less eager. An excellent demand for copper is reported, but the market is held down to 14 cents by the selling of the large producers who seem to fear that a higher price would lead to the reopening of the smaller mines and a burdensome increase in the supply.

The "edge" appears to be temporarily off the cotton market as in the light of the ginning figures the crop looks a little larger than previously. But the demand for cotton goods is excellent and most of the mills are sold well ahead. Sugar is firmer on the strong statistical position. Wool and woolen goods are steady without appreciable change in price. Rubber is slightly higher. Silk is a shade easier. Hides and leather are steady, reflecting an excellent shoe business, although the upholstery demand is poor.

Our foreign trade figures for October show exports valued at $372,000,000 as against $343,000,000 last year. This is both surprising and encouraging. Imports are not yet reported, the delay being due to the rush caused by the tariff bill.

The news from Europe is still rather sombre. Germany continues to print paper marks at the rate of several billion daily in an effort to avert the inevitable deflation. Financial England seems somewhat heartened by the victory of the Conservatives, but industrial Lanchasire is rather less cheerful and some short time is reported. Sterling exchange has advanced sharply and francs followed but only to lose most of their advance. French business seems to be fairly prosperous despite the financial predicament of the government.

From Russia an amazing recovery is reported since the Soviet government permitted a partial resumption of capitalistic practices, but the news is almost too good to be entirely true and it is probably colored by the self interest of those in power.

Mexico seems to be still in a state of financial instability and irritability, but the outlook elsewhere in Latin America and especially in Cuba is satisfactory and encouraging. In Canada good crops and a dollar that is worth more than 100 American cents are creating a consciousness of prosperity.

Speaking generally it may be said that in the Western hemisphere Thanksgiving Day may be celebrated with real thankfulness for blessings already enjoyed, but in Europe it will be chiefly observed with the gratitude that has been defined as "a lively appreciation of favors yet to be received."

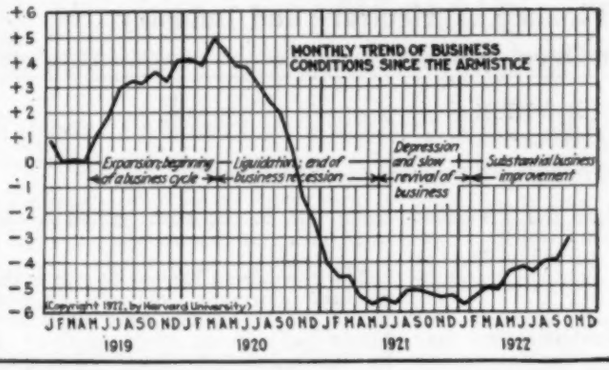
U. S. Leads in Railway Mileage

In the following table, prepared by the Bureau of Railway Economics, the railway mileage of the United States is compared with that of some of the other countries by indicating, through multiples, how many times the mileage of the United States exceeds that of the other countries.

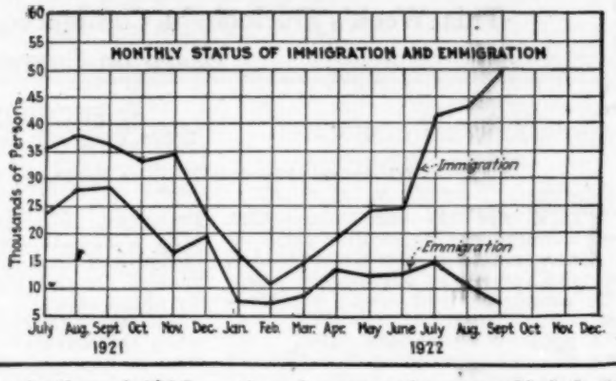
	Railway Mileage	Ratio of U. S Mileage to Mileage of Country Named
United States	264,373	.....
Russia (incl. Asiatic)	51,646	5.1 times
Canada	38,888	6.8 times
British East Indies	36,325	7.3 times
Germany	36,131	7.3 times
France	35,145	7.5 times
United Kingdom	24,396	10.8 times
Argentina	23,156	11.4 times
Brazil	17,478	15.1 times
Mexico	15,841	16.7 times
Italy	12,501	21.7 times

"In other words," says the Bureau, in commenting on the comparison, "the railway mileage of the United States is five times as great as the mileage of Russia, which contains the next largest system of railways.

Monthly status of immigration and emigration in the United States based on returns collected and compiled by National Industrial Conference Board.


MONTHLY TREND OF BUSINESS CONDITIONS SINCE THE ARMISTICE
Expansion; beginning of a business cycle
Liquidation; end of business recession
Depression and slow revival of business
Substantial business improvement
(Copyright 1922, by Harvard University)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1919
1920
1921
1922

Trend of business conditions in the United States based on Bradstreet's price index and Bank Clearings outside of New York as computed by Harvard Economic Bureau.


MONTHLY STATUS OF IMMIGRATION AND EMMIGRATION
Thousands of Persons
Immigration
Emmigration
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1921
1922

BUSINESS conditions since the armistice as reflected in the statistics of the Harvard Economic Bureau show that the slow revival of business which set in about January of the current year is continuing steadily upward, with a substantial business improvement reflected in October. Bank clearings outside of New York and Bradstreets price index upon which the curve of business conditions is based show an improvement in October as compared with September of seven-tenths of one per cent.

Bond prices as reflected from the average of 40 representative issues in the New York market fell off slightly in October to $80.82 as compared with $82.14 in October. The decline was largely in sympathy with the share markets, but of no great significance. High grade bonds continue to be attractive and in demand and the average price of the 40 issues shows a progressive advance from $69.71 in January 1921 to the October average without any reaction in that time.

Production of manufactured goods in the United States continues to show the heavy volume which began in May of the current year. The total volume of manufacture reached 99.1 per cent in June, declining slightly in July to 95.3 per cent. Estimates for August and September point to a record volume of production of 104.6 per cent and 101.3 per cent respectively. The chief commodities showing increases of considerable proportions over the early months of the current year are lumber, petroleum, textiles and food.

Comparative Prices of Shop Supplies

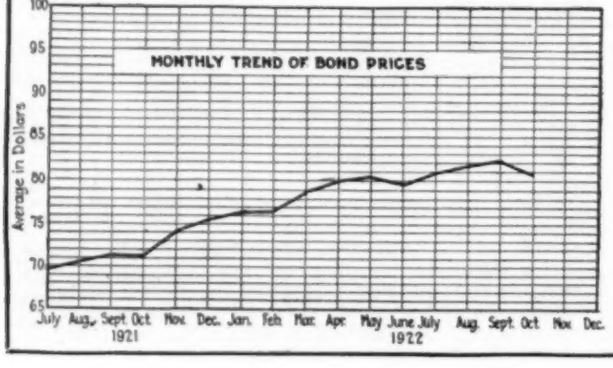
Average of New York, Chicago and Cleveland Prices

	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0295	$0.0295	$0.0273
Cold finished shafting	per lb.	0.0378	0.0378	0.0373
Brass rods	per lb.	0.171	0.1700	0.15
Solder (½ and ½)	per lb.	0.24	0.23	0.20
Cotton waste	per lb.	0.11	0.11	0.122
Washers, cast iron (½ in.)	per 100 lb.	4.33	4.33	4.33
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.11	3.11	.....
Lard cutting oil	per gal.	0.59	0.575	.....
Machine oil	per gal.	0.36	0.36	.....
Belting, leather, medium	off list	30–10% @50%	40–5% @50%	
Machine bolts up to 1 x 30 in.	off list	55% @60%	50%@ 65–10%	50%@ 60–10%

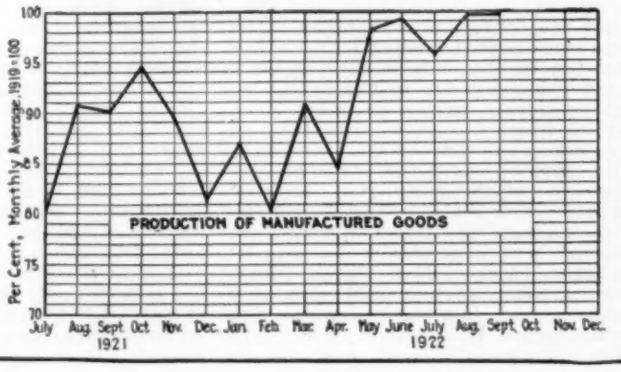
Serious labor shortage, both skilled and unskilled, continues to occupy the attention of the majority of essential industries. Manufacturers associations in convention assembled during the past few months have been unanimous in declaring themselves against the present immigration legislation and in many cases they have passed resolutions favoring amendments to the acts so as to permit the necessary labor to enter this country. Statistics compiled by the National Industrial Conference Board show that since January, 1921, up to date the net gain in immigration over emigration has averaged less than 13,000 persons per month. The result has been a great shortage of workers and a consequent bidding up of labor rates to draw men from one industry into another. One of the matters which will, without doubt, be brought before the next Congress, will be some measure of legislation calculated to relieve the serious situation which has developed, from which all industries suffer.

Loadings of revenue freight continue to be the heaviest in the history of American roads. For the week ending Nov. 11, a total of 953,909 cars were loaded, an increase of 198,132 cars as compared with the corresponding week of last year and an increase of 26,323 cars compared with the corresponding week in 1920. Car shortage continues serious, the total shortage on November 8 totaling 174,498 cars, a decrease of about 4,000 cars from week previous.

Monthly movement of bond averages based on weekly prices of 40 representative railroad and industrial issues compiled and furnished by Times Annalis.


MONTHLY TREND OF BOND PRICES
Average in Dollars
July Aug. Sept Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1921
1922

Percentage of total manufacture of steel, lumber, paper, petroleum, textiles, leather, food and tobacco compiled by Federal Reserve Board.


PRODUCTION OF MANUFACTURED GOODS
Per Cent, Monthly Average 1919=100
July Aug. Sept Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1921
1922

Decrease in Bad Order Locomotives

The railroads of the country repaired and turned out of their shops during the period from Oct. 15 to Nov. 1 last the largest number of locomotives for any semi-monthly period in approximately the last two years, according to reports received today from the carriers by the Car Service Division of the American Railway Association.

During that semi-monthly period, 13,490 locomotives were repaired. This also exceeded by 2,086 the number turned out of the shops from Oct. 1 to Oct. 15 last.

Locomotives in need of repair on Nov. 1 totaled 18,366, or 28.5 per cent of the number on line. This was a decrease of 865 since Oct. 15, at which time 19,231, or 29.8 per cent were in need of repairs.

Of the total number on Nov. 1 last, 15,101 were in need of repairs requiring more than 24 hours. This was a decrease since Oct. 15 of 834 locomotives in the number needing heavy repairs. The remaining 3,265 represented locomotives in need of light repairs, which was a decrease of 31 within the same period.

Reports filed by the carriers show that on Nov. 1 the railroads had 46,096 serviceable locomotives.

Weirton Steel Co. Will Erect Big Sheet Mills

Eight sheet mills involving an outlay of $1,500,000 will be erected in Weirton, W. Va., within a year by the Weirton Steel Co., according to an announcement last week by D. M. Weir, vice-president of the company. Five hundred men will be afforded employment by the completion of the new unit. The output of the mills, Mr. Weir said, would be restricted to black and galvanized sheets and the new department would be conducted entirely separate from the tin unit of the plant.

The construction of the battery of sheet mills will bring the number of hands employed by the Weirton Co. close to the 16,000 mark.

Southern Metal Industry Expanding Trade with South America

Southern metal trades industries have been experiencing an unusual increase in export sales to Latin-American countries the past five or six weeks, according to William E. Dunn, Jr., secretary of the Southern Metal Trades Association, who advises that metal trades products made in the South are in greater demand now in all Latin-American countries than in the past two years. Central, South American and Cuban trade is especially good, with Brazil and Argentine trade in the lead. Porto Rican conditions are rapidly improving, and border trade with Mexico has increased rapidly during the past two months. The outlook, Mr. Dunn states, is for the largest export business with Latin-American in 1923 that the southern metal trades industries have yet experienced.

New Process Gear Plans Expansion

Definite plans for the expansion of the New Process Gear Corporation of Syracuse, recently purchased for $2,100,000 by T. W. Warner, of Toledo, vice-president of the Durant Motors, Inc., are being worked out. The plant has been working at full capacity producing gears for both the Durant and Star cars for several months, and it is understood that the plans being formulated call for a larger plant. C. R. Burt is managing the plant for Mr. Warner, and it is understood that he will remain at the head of it.

The Alliance Machine Co., Alliance, Ohio, according to reports, has booked orders for thirty-one cranes and hoists during the past month.

Supreme Court Denies Duesenberg Claim

The possibility of an armistice ending the world war was a factor influencing contracts for war supplies in which the contractor should share responsibility in certain classes of cases, according to a decision of the United States Supreme Court, rendered Nov. 13 in denying a claim of the Duesenberg Motors Corporation against the government for $152,808.93. The Court of Claims had dismissed the claim and the Supreme Court upholds this action.

The Duesenberg corporation entered into a contract to manufacture airplane motors, the contract being changed twice, first to enlarge an order for Liberty motors and later to change the type to Bugotti motors. Specifications were delayed and at the same time the plant was not fully ready, when the armistice ended the need for the motors. The corporation claimed the $152,808.93 to be due it in addition to the amounts which were paid it by the government.

Leather Belt Men Hold Educational Sessions

A three-day educational session of the Leather Belting Exchange was held at the Hotel Pennsylvania, New York, N. Y., November 16, 17, 18. As the purpose of the meeting was to interest the members in the finer points of leather belting manufacture, the main feature was a description of the experimental work carried on by the scientific research committee in its laboratory at Cornell University.

R. F. Jones, the research director, discussed "Research Work in Leather Belting," following his address with a demonstration of a miniature of the apparatus in use at the Cornell laboratory. Among the other subjects taken up were: How a Belt Transmits Power, by J. E. Rhoads, chairman research committee; The Belt vs. the Motor—the Costs of Belt Tensions, by R. C. Moore, chief engineer, Chas. A. Schieren Co.; The Chain Drive in Its Relation to Leather Belting, by C. O. Streeter, mechanical engineer, Graton & Knight Manufacturing Co. The same program was given Thursday and Friday with the substitution of Dr. R. R. Tatnall, chief engineer, J. E. Rhoads and Sons, in place of J. E. Rhoads in the discussion of How a Belt Transmits Power.

Locomotives for the Polish Railways

According to a report recently received, the Polish Railway Administration has placed orders for 25 locomotives in the United States and 20 locomotives in Switzerland, aggregating $900,000. Further orders have also been placed during the last few days with Austrian works. The latter are for locomotives of a lighter type and will be used on the Galician sections of the State Railways.

The Polish Government has also placed an order for 150 big tank cars with the French Arbel Works.

Business Items

The Manufacturers' Polishing and Platers' Supply Co., of Bridgeport, Conn., incorporated the past week, to manufacture polishing and platers' supplies, buffing tools, etc., has taken a lease on 6,000 square feet of floor space in a portion of the old Morris Metal Goods Co. plant on Union Ave., that city, and plan to begin operations Dec. 1.

The Perry Laundry Machinery Co., of Fairhaven, Mass., has incorporated under the laws of Massachusetts, to manufacture laundry and other machinery, etc., The capital stock is $100,000, and the incorporators are: Frank Vera, Emanuel J. Perry, 1352 Rockdale Ave., New Bedford, Mass., and M. V. Sequeria. Mr. Vera has been chosen president, and Mr. Perry is the treasurer of the company.

The Guy Steel Casting Co., Elmwood, a suburb of Hartford, Conn., has, during the past week, filed a certificate of dissolution with the Secretary of the State of Connecticut. The firm has decided to cease business, and claims may be sent to Mr. George B. Kinghorn, 776 New Britain Ave., Hartford, Conn. The company made steel castings, etc.

The Acme Shear Company, Bridgeport, Conn., large manufacturers of shears, cutters, etc., has recently increased the capital stock of the concern from $500,000 to $1,000,000. A certificate to that effect was filed during the present week with the Secretary of the State of Connecticut.

The Moore Drop Forging Co., Springfield, Mass., is about to build a new machine shop to be located close to the drop forging plant. It is to be 93 x 35, one story and will cost $20,000. McClintock & Craig of Springfield are the architects and L. S. Wood has the building contract.

The Dominion Wheel and Foundries Co., Toronto, has recently acquired the plant at Cobourg, Can., formerly occupied by the Crossen Car Co., in which it is making brake shoes and general castings.

The Alloy Steel Castings Co., the plant of which is located at Levittsburg, Pa., has been granted authority at Columbus, Ohio, to increase its capital stock in the amount of $300,000, making its total capitalization $450,000. O. R. Grimmesey, treasurer of the com-

pany, says that the increase will augment the company's output approximately 100 per cent.

The Hykon Manufacturing Co., Canton, Ohio, manufacturer of automobile and electrical tools, suffered a loss from fire during the the past week estimated at $9,000.

The Premier Manufacturing Co., of Sandy Hook, Conn., manufacturer of electric, gas and water instruments, has, during the past week, acquired the business of the W. & B. Douglas Co., Middletown, Conn., manufacturer of pumps and equipment since 1832. The same firm has also acquired the business of the Standard Metal Work Corporation, of Thompsonville, Conn., manufacturer of sheet metal parts, etc. Charles H. Cole, president of the Premier Co., states that the concern will probably have a capital stock of about $1,500,000, and that the general office of the companies will be removed to Middletown, using the Douglas plant as main headquarters. The other plants will still be in operation and they will continue to make the various articles as heretofore.

The Locomobile Co. of America at Bridgeport, Conn., by order of Referee Keogh, has been formally transferred to the trustees of the new Locomobile Co. of America, a new York corporation, controlled by W. C. Durant.

The General Motors Corporation estimates that 1922 sales will aggregate 468,355 motor vehicles. In the first three-quarters of the year 316,136 cars and trucks were produced.

The Hayes Wheel Co. of Canada, Ltd., recently purchased the plant of the General Forgings and Stampings, Ltd., at Meriton, Can., and will equip it to produce automobile rims.

The Apex Tool and Stamping Co., 4830 Southern Parkway, Louisville Ky., has been organized recently to manufacture tools and stamped metal goods.

The National Forge and Tool Co., Irvine, Pa., is planning to increase its manufacturing facilities by installation of additional equipment.

The Mid-City Railroad Co. has been incorporated at Haines City, Fla., with $250,000 capital, and plans construction and operation of a line between Haines City and Polk City, fifteen miles, and a later forty mile extension to Clermont, Fla., thence to Dade City, thirty-five miles. Isaac Van Horn is named president of the company.

The Broadfoot Iron Works, of Wilmington, N. C., according to W. G. Broadfoot, president, has under construction additional units representing total investment of about $200,000. The company conducts a business in boiler and general machine and welding work.

The Anderson Tractor Co., manufacturer, has been organized at Anderson, S. C., with $200,000 capital, by William S. Anderson and associates.

The Street Bros. Machine Works and the Patten Manufacturing Co., both of Chattanooga, and among the South's largest manufacturers of hoisting machinery, have consolidated under the name of the Street Brothers Machine Works, Inc., according to J. H. Street, who continues as president of the enlarged company. J. W. Burrell, sales manager of the Patten company, continues as sales manager of the merged company.

The H. H. Chase Co., has been organized at Jamestown, N. Y. by H. H. Chase, formerly superintendent of the Salisbury Axle Co., of that city. The company will manufacture handle lock socket wrenches.

The Moon Motor Car Co. reports net profits of $326,478 for the quarter ended Sept. 30.

The Monitor Controller Co., Baltimore, Md., manufacturer of the "Just Press a Button" system of automatic control for all motor-driven apparatus has recently established in the South a branch office at Birmingham, Ala.

The Instant Heat Device Co. has been incorporated at Miami, Fla., with $300,000 capital, to establish a plant for the manufacture of a recently invented quick heater. W. A. Brown, of Miami, heads the company.

Olmstead, Kent & Co., has been organized at Orlando, Fla., with $25,000 capital it is announced by Lucien L. Olmstead, of Orlando, the new company to handle machinery, machinery supplies and engineering supplies at wholesale and retail. Mr. Olmstead is president, Roscoe Kent, vice-president and Robert E. Duckworth, secretary and treasurer.

Sugg Brothers, of Carthage, N. C., machine shop operators, announce plans for the immediate construction of a large shop, which, including new machinery to be installed, will represent an investment of several thousand dollars.

The Kalman Steel Co., at Youngstown, Ohio, operating a reinforcing bar plant, is installing machinery that will increase its capacity 50 per cent, says Supt. West. Next year the company will add a unit 76 x 376, giving the local plant about double its present capacity. Announcement is made that the Kalman Steel Co. has taken over the Foughner Steel Co. of New York.

The Studebaker Corporation, in its report for the third quarter shows a total production of 87,951 cars as against 56,163 in 1921. The total production for 1922 is expected to be about 110,000.

The Roller-Smith Co., 233 Broadway, New York City, announces the appointment of the Electric Material Co. as its agent in the State of Washington and parts of Oregon and Idaho. The Electric Material Co. has recently opened an office in the Hinckley Building, Seattle, and will handle the Roller-Smith Co.'s lines of electrical instruments, circuit breakers and radio apparatus in that territory. The Seattle office is in charge of R. F. Robinson, formerly connected with the Western Electric Co., and the Pacific Telephone and Telegraph Co. The Electric Material Co.'s main office is at 589 Howard St., San Francisco, Calif., and it also has a branch office in the Title Insurance Building, in Los Angeles. Roller-Smith apparatus is handled by both of these offices as well as the Seattle office which means that the Electric Material Co. represents the Roller-Smith Co. along the entire Pacific Coast.

The McClain Co. has been incorporated at Portland, Me., to manufacture wood and metal working machinery and tools. The directors are Frank H. McClain, treasurer; Clark B. Dunton and Henry L. Cheney.

The Somerset Machine Co. has been incorporated at Skowhegan, Me., to manufacture and repair tools and machines, with a capital of $10,000. The directors are: President, Oscar Thompson of Skowhegan; treasurer, Wallace S. Clark, Skowhegan, and Frank C. Fellows of Brookline, Mass.

The Victor Tool Co., Waynesboro, Pa., announces the appointment of the J. F. Buhr Machine Tool Co., 7762 Dubois Ave., Detroit, Mich., to represent the entire line of Victor products in Eastern Michigan.

Personals

WILLIAM T. RAYNER, treasurer of the Gilbert & Barker Manufacturing Co., Springfield, Mass., sailed recently on a pleasure trip through the South American countries. Mr. Rayner expects to be in the South for several weeks.

A. SKIDMORE, for many years associated with the Ayer-O'Connell Manufacturing Co., of Meriden, Conn., has been chosen superintendent of the Manufacturers' Polishing and Platers Supply Co., recently incorporated and organized to manufacture platers' supplies, buffing tools, etc., of Bridgeport, Conn.

FREDERICK G. HUGHES, vice-president of the New Departure Manufacturing Co., Bristol, Conn., has been elected president of the Bristol Chamber of Commerce, and will assume the duties of that office immediately.

MITCHELL S. LITTLE, president of the M. S. Little Manufacturing Co., of Hartford, Conn., and affiliated with several other industrial companies of Hartford, and vicinity, was, during the past week, elected a director of the Ætna Life Insurance Co., of Hartford, filling a vacancy caused by the recent death of the Hon. Morgan Gardner Bulkeley, former Governor of Connecticut, and Ex-United States Senator.

F. F. ROHRER, assistant to the manager of both the power and railway departments of the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa., has been appointed general contract manager of that company. In his new appointment, which is effective immediately, Mr. Rohrer will be a member of the staff of W. S. Rugg, general sales manager.

PAUL M. LINCOLN, past president of the American Institute of Electrical Engineers, and for many years associated with the Westinghouse Electric and Manufacturing Co., has been appointed director of the School of Electrical Engineering in the College of Engineering, Cornell University, to succeed the late Professor Alexander Gray.

D. K. HUTCHCRAFT, formerly vice-president of the Indiana Air Pump Co., Indianapolis, and one of the leading authorities on air lift pumping, has been appointed district manager of the Chicago Pneumatic Tool Co.'s branch office recently established at Tulsa, Okla.

EARLE M. HAYES, formerly general manager of and for the past five years with Hunter & Havens, steel, iron and mill supply merchants, Bridgeport, Conn., has just been appointed general manager of steel sales of the American Tube and Stamping Co., Bridgeport, Conn.

EDWARD T. OLIVER has been appointed to represent the Victor Tool Co., Waynesboro, Pa., manufacturer of taps, die heads, reamer holders, etc., in the Northern Ohio territory. He will make his headquarters at 2031 Lincoln Ave., Lakewood, Cleveland, Ohio.

THOMAS K. GLENN, head of the Atlantic Steel Co., of Atlanta, for many years, and one of the best known iron and steel manufacturers in the southern field, has been named to the presidency of a new banking corporation formed in Atlanta this month by the consolidation of the Lowry National Bank and the Trust Company of Georgia.

H. H. GILDNER, formerly with the S K F organization in New York, has become associated with the Timken Roller Bearing Co. as district manager of sales in the Chicago territory.

JOHN H. PECKHAM, for many years connected with the Norton Grinding Co., Worcester, Mass., has now joined the selling department of Henry Prentiss and Co., New York. Mr. Peckham will act as grinding machine specialist for the sales and service ends.

D. W. PITCOCK, former superintendent of the Massillon Rolling Mill Co., Massillon, Ohio, has become general superintendent of the Universal Steel Co., at Bridgeville, Pa.

CHARLES B. WILSON, vice-president and general manager of the Willys-Overland Co., Toledo, Ohio, has resigned to return to Pontiac, Mich., as active president of the Wilson Foundry and Machine Co., of which he was president and general manager until his active affiliation with the Willys organization late in 1920.

WILLIAM H. WARREN, former general manager of the Gary plant of the Illinois Steel Co., and of the Brier Hill Steel Co., has been appointed general superintendent of the Trumbull Steel Co., at Warren, Ohio.

H. B. NEWTON, purchasing agent for the Thew Shovel Co., Lorain, Ohio, has been named to do the purchasing also for the Universal Crane Co., an affiliated company, Elyria. All the buying will be done at Lorain.

STANLEY B. MATHEWSON, factory manager of the old Elwood-Meyers Co., Springfield, Ohio, has resigned to become director of personnel of Antioch College, Yellow Springs, Ohio, succeeding H. L. Gardner, who has been made assistant to the general manager of the Shelton Looms, Shelton, Conn.

A. W. IRVING, formerly with the Holden Co. of Canada, has joined the sales organization of the Canadian Machinery Corporation, Toronto.

WILLIAM GAMBLE, formerly with the Moline Plow Co. at Poughkeepsie, N. Y., has been appointed purchasing agent of the Rock Island Plow Co., Rock Island, Ill.

J. W. LEROUX, of Atlanta, for several years southeastern representative of the Virginia Bridge and Iron Co., of Roanoke, Va., has resigned, effective Jan. 1, 1923, and will thereafter devote his entire time to industrial development work in the southern field. E. S. Humphries, of Roanoke, has been named to succeed Mr. Leroux.

COLONEL WILLIAM L. SCOTT, of Atlanta, for the past eight years sales manager in the southern territory for the Ohlen-Bishop Co., of Columbus, Ohio, and one of the South's best known machinery and saw men, has tendered his resignation to this company and accepted a similar position with the American Saw and Manufacturing Co., of Springfield, Mass. He will make his headquarters in Atlanta at 42 West Alabama St.

Obituary

WALTER M. SPAULDING, chairman of the board of directors of the Graton & Knight Manufacturing Co., Worcester, Mass., and identified with that company for more than 50 years, of which 13 years were as president, died at his home in that city, Nov. 16, aged 76 years. He retired as president last March.

MYRON E. REAM, vice-president of Leffingwell-Ream Co., management engineers, died suddenly November 17, in Chicago.

WILLIAM MAURER, 63 years old, prominent South Bend, Ind., manufacturer and owner of the Maurer Machine Works, died recently in that city.

JAMES BUTTERWORTH, retired manufacturer of textile machinery, died November 14, at his home, No. 252 Pelham Road, Mt. Airy, Philadelphia, Pa., aged 82 years. Born in that city, he entered the service of his father, head of the H. W. Butterworth & Sons' Co., in 1857, and was admitted to the firm in 1889. He was its president when he retired 10 years ago.

Book Reviews

Foreign Commercial Credits. By George W. Edwards, Assistant Professor of Banking, School of Business, Columbia University, and Research Assistant, Federal Reserve Board. Two hundred thirty-eight 6 x 9 in. pages, cloth boards. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York, N. Y. Price $2.50.

A welcome addition to our rather meager literature dealing with foreign trade. The United States, as a nation is probably less well founded in fundamentals of foreign trade than any other large nation, yet must realize that eventually she will engage extensively in that type of commerce. On that account this book, which takes up the letter of credit, the fundamental method of financing foreign trade for many years, should be of great value to those who wish to understand how to do business abroad. Practical and legal principles underlying the letter of credit are explained.

An introduction by H. Parker Willis is followed by chapters on the movement toward uniformity in commercial documents, present status of shipping documents meaning and classification of letters of credit, operation of letters of credit, travelers' letters of credit, the letter of credit in American law—principles, the letter of credit in American law—decisions, the authority to purchase, the trust receipt, British commercial credits, the letter of credit in British law, German commercal credits, commercial credit practice of Japanese banks, commercial credit practice of some continental banks.

There are appendices on commercial credit instruments, uniform commercial credit regulations of the commercial credit conference, the Hague rules, 1921, points of variance between the Hague rules and the Harter act, American foreign trade definitions, Diamond Alkali Export Corporation vs. Bourgeois.

Manchuria: Land of Opportunities. Published by the South Manchuria Railway, Dairen, Manchuria. Boards, 113 6 x 9 pages, 100 half tones, map and 10 charts.

This book tells the story of the amazing transformation that has taken place in Manchuria. The development of this country has been made possible by the South Manchuria Railway, with its American equipment, its coal and iron mines, steel works, electric plants and industrial works.

Known only a few years ago as "The Forbidden Provinces," this section of China has made almost unbelievable strides since the close of the Russo-Japanese War, when Russia's rights in the country were transferred to Japan. The traveler in Manchuria rides in a Pullman sleeping car, drawn by a Baldwin Locomotive over 100 lb. rails made in Pittsburgh.

Riding from the modern part of Dairen northward through cities lighted by electricity, with their fine railway stations, paved streets, hotels, schools, hospitals and scientific laboratories; past American equipped steel works, coal mines and factories, the transformation is so great that the traveller can hardly believe he is in a land which only a few years since was the home of the Manchu rulers of China and a forbidden land to world commerce.

The book is absorbingly interesting and gives one an insight into this almost unknown country that cannot be obtained from any history.

Fundamentals of Practical Mathematics. By George Wentworth, David Eugene Smith and Herbert Druery Harper. One hundred ninety-eight 5 x 7 in. pages, cloth boards. Illustrated. Published by Ginn & Co., 15 Ashburton Place, Boston 2, Mass. Price $1.20.

The authors divide the book into chapters on fundamental operations, ratio and proportion, mensuration, trigonometry, the slide rule, and general applications. From a consideration of those divisions it may be seen just what they include under "fundamentals."

There are two general points to be considered in any book, content and arrangement. Much praise may honestly be given to both in "Fundamentals of Practical Mathematics." Beginning with a review of addition, subtraction, multiplication and division of whole numbers, decimals and common fractions, the student is led by easy steps through elementary trigonometry, which is followed by a chapter on the slide rule.

Arrangement of the contents eliminates almost all inconvenience. Problems and the illustrations to which they refer are printed on facing pages. The first page after the table of contents contains an explanation of symbols. The last two pages of text consist of definitions of mechanical terms. Text dealing with trigonometry is followed by four-place tables of the natural functions. A feature of the book is that the line cuts are printed in blue, showing a white line on a blue background, in that way teaching the student how to read blue prints. As the problems refer to the cuts, the blue prints must be used constantly.

Problems of the type that the student will meet in his work have been selected. Mathematics is shown to be a practical subject, not merely one used to exercise the mind.

Motor Vehicle Engineering—The Chassis. By Ethelbert Favary, author of "Motor Vehicle Engineering—Engines." Four hundred sixty 6 x 9 in. pages, 515 illustrations, cloth boards. Published by the McGraw-Hill Book Co., 370 Seventh Ave., New York, N. Y. Price $5.00.

The author has attempted, and to the reviewer he seems to have very satisfactorily accomplished, the embodiment of information that may be applied by students, and those engaged, or wishing to become engaged, in the automotive industry, to actual work. For clarity in presentation the contents of such a book naturally fall into several divisions. In this book they deal with chassis layout, mechanics of materials, frames, clutches, shafts and universal joints, transmission or change speed gears, rear axles, rear axles for trucks, rear axle loads and stresses, torque arms, thrust-, radius-, and truss rods, brakes, front axles, steering gears and other subjects.

There is little of a historical nature about the book and it is in no sense merely a compilation of information showing present day practice. Underlying principles have been stated and explained clearly. Only elementary mathematics has been used. To quote from the preface, "The method pursued in the treatment of the subject is largely a result of the author's work as consulting engineer, his experience with draftsmen and designers and his lectures on motor vehicle design at Cooper Union to men engaged in the industry."

Machine Shop Mathematics. By George Wentworth, David Eugene Smith and Herbert Druery Harper. One hundred fifty-eight 5 x 7 in. pages, cloth boards. Illustrated. Published by Ginn & Co., 15 Ashburton Place, Boston 2, Mass. Price $1.20.

The second book of a series (the first is "Fundamentals of Practical Mathematics," reviewed in American Machinist, page 868c). The purpose of the book, the authors declare, is "to meet the needs of students who expect to become machinists, either in the special line of automobile construction or in the more general lines.

Measuring Instruments is the title of the first chapter. It is followed by chapters on speeds and feeds, tapers and taper turning, screw threads, indexing and spiral cutting, gears, review problems. Reference tables include tables of measures, decimal equivalents, natural trigonometric functions, powers and roots, sizes of twist drills with decimal equivalents, speeds of drills, sizes of screw threads and tap drills, and others. The problems are thoroughly practical and well presented.

1922 Year Book of the Merchants Association of New York. Published by the Association. Paper cover; 328 pages with index.

The book is a complete record of the activities of the Association. It contains a list of the complete executive personnel, the make-up of its various departments, their functions and duties, reports of the various officers for the past year and the names of the members of the association.

Export Opportunities

The Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., has inquiries for the agencies of machinery and machine tools. Any information desired regarding these opportunities can be secured from the above address by referring to the number following each item.

Machine for making cement blocks—Mexico. Purchase desired. Quotations, f.o.b. New York or New Orleans. Payment, cash. Reference No. 4296.

Clay working machinery suitable for making pottery, fancy tiles and particularly electric porcelains, and also glazing material of various colors for the above articles—China. Purchase desired. Quotations, c.i.f. Chinese port. Reference No. 4277.

Batteries and magnetos for motor cars, lighting, etc.—South Africa. Purchase and agency desired. Quotations, f.o.b. New York. Payment to be made in New York. Reference No. 4278.

Seamless solid drawn steel tubes from ⅛ to 12 inches in diameter—Scotland. Purchase desired. Quotations, c.i.f. Scottish port. Terms: Payment against documents. Reference No. 4279.

Machines to make twisted-wire brushes of all kinds—Canada. Purchase desired. Payment, cash. Reference No. 4281.

A pneumatic metal sprayer for use in spraying zinc, tin, copper, nickel and other metals on cast iron, etc.—Norway. Purchase desired. Quotations, f.o.b. New York. Reference No. 4291.

Electrical goods and equipment of every kind, household and building hardware and agricultural implements—Ireland. Agency desired. Quotations, c.i.f. Dublin. Reference No. 4338.

A rotating or circular shearing machine—France. Purchase desired. Quotations, c.i.f. French port. Terms, cash with order. Correspondence, French. Reference No. 4255.

Machinery for the manufacturing and polishing of all types of lamp reflectors—England. Quotations, c.i.f. English port. Terms, cash against documents. Reference No. 4257.

Wire nails, cut nails, machine screws, wood screws, hinges, steel latches, sandpaper and waterproof and casein glue—Switzerland. Purchase desired. Quotations, c.i.f. Antwerp. Payment, cash in advance. Reference No. 4265.

Wire rods and steel plates—England. Purchase or agency desired. Quotations, f.o.b. New York. Reference No. 4273.

Machinery and tools for the equipment of a factory to turn out 200 clocks per day, and also machinery for the manufacture of metal and wooden clock cases—India. Everything except springs to be manufactured in factory. Purchase desired. Quotations, c.i.f. port of India. Reference No. 4342.

Agricultural machines, tractors, automobiles (lighter and cheaper cars), motor trucks (1½ to 3 tons), and motors of various descriptions—Baltic Provinces. Purchase and agency desired. Quotations, c.i.f. Baltic port. Correspondence, German. Reference No. 4350.

Motor cars, motor cycles and accessories, spares and tools of every description—India. Purchase and agency desired. Quotations, f.o.b. New York. Reference No. 4352.

One hundred copper steam tubings, each of 5 meters in length, diameter 70 millimeters, and thickness 2 millimeters—Greece. Purchase desired. Quotations, f.o.b. New York. Payment arranged by confirmed letter of credit in New York. Reference No. 4353.

All sorts of radio-telegraphic apparatus and precise measuring instruments for radio laboratories, such as amperemeters and voltmeters—Czecho-Slovakia. Catalogues and price lists are desired. Reference No. 4354.

Plant for the development of power facilities, or equipment for the extension of existing electric light plant through the agency of crude oil engines or water—Canada. Purchase desired. Quotations, literature and catalogues requested. Reference No. 4355.

Mechanical specialties and specialties of all kinds (excepting automobile accessories), and also general merchandise of all kinds—South Africa. Inquirer is in the United States for a short time for the purpose of securing agencies. Reference No. 4360.

Machinery for the equipment of a factory for the manufacture of cork products—Italy. Purchase desired. Quotations, c.i.f. Italian port. Payment: Cash against documents. Reference No. 4361.

Galvanized sheets, 1 by 2 meters, in two thicknesses, 0.55 and 0.65 millimeter—Switzerland. Purchase desired. Quotations, c.i.f. Antwerp. Terms: Cash. Reference No. 4363.

Solution for removing rust or for loosening rusted screws and bolts—Italy. Purchase desired. Quotations, c.i.f. Italian port. Payment: Cash. Reference No. 4368.

Agricultural implements and machinery—Japan. Purchase and agency desired. Quotations, c.i.f. Kobe or Yokohama. Terms: Payment against documents. Reference No. 4370.

Electrical goods of all kinds, labor-saving machinery, machine tools, rubber belting, rubber hose, metals, rails and novelties in the engineering line—Sweden. Agency desired. Quotations, f.o.b. New York. Reference No. 4371.

Electrical apparatus of all sorts and machinery in general—Spain. Agency desired. Terms: Payment upon receipt of merchandise. Correspondence, Spanish. Reference No. 4372.

Large machine for the reconditioning of worn and flattened electric car wheels—Spain. Purchase desired by railway company. Quotations, c.i.f. Spanish port. Terms: Cash on delivery of machinery. Correspondence, Spanish or French. Reference No. 4385.

Refractories—Italy. Purchase desired by manufacturer. Quotations, c.i.f. Italian port. Reference No. 4386.

Trade Catalogs

Gear Grinding. The Lees-Bradner Co., Cleveland, Ohio. This company has just issued a new publication of sixteen pages, with an attractive arrangement, on the subject of gear grinding. The publication features the Lees-Bradner product in the line of grinders for this work and contains eleven selected illustrations. It sets forth in detail a quantity of output process that finishes spur gears after hardening, maintaining standards of accuracy and quietness in the product. A feature of the publication is the discussion of the principles of the involute curve, the development of the involute tooth, proving the involute principle and the rack form and the process of generating gear teeth of this type on the Lees-Bradner machines. The illustrations show not only the general assembly of the grinders but give details of construction as well.

Flexible Shaft Applications. The S. S. White Dental Manufacturing Co., Philadelphia, Pa. A new sixteen-page publication just issued by this company is entitled "From Sheep Shears to Speedometers and Other Applications of the Flexible Shaft. It is a general review of the progress made in recent years of the development of flexible shafts by this company, tells how they are made and sets forth their many uses in numerous industries.

Brown Pyrometers. The Brown Instrument Co., Philadelphia, Pa. This company has just issued a new folder featuring the Brown method of automatic temperature control on furnaces in shops, etc., for hardening and tempering tools.

Portable Undercutting Equipment. The S. S. White Dental Manufacturing Co., Philadelphia, Pa. A new four-page folder just issued by this company illustrates and describes its portable undercutting equipment, handpieces and flexible shafts designed especially for cutting down the mica between commutation segments.

War Surplus. The U. S. War Department, Director of Sales, has just issued a small pamphlet describing, in a general way, the methods of sale resorted to by the Department in the disposal of its stocks of surplus property. The pamphlet tells what these stocks consist of and contains a loose-leaf insert listing the dates of the important sales scheduled for the near future.

General Electric Catalog for 1921. The General Electric Co., Schenectady, N. Y. The company has just issued its general catalog for 1921, of 1338 pages with a catalog number index and a subject index. The catalog gives a representative listing of the company's products obtainable through its sales offices and distributors, all of which are given. The information on supplies also includes identification for ordering and, in most cases, prices also. The catalog supersedes all previous publications.

Power Punching Presses. The Niagara Machine and Tool Workers, Buffalo, N. Y. The company has just issued Bulletin No. 61 of twenty-four pages on its line of power punching presses, series Nos. 30-40-110. The bulletin is fully illustrated with views of the various types of machines and contains cuts showing construction details as well as specifications on each style and size.

Commercial Rust Remover and Pickling Compound. Peter A. Frasse and Co., Inc., 417 Canal St., New York City. This company has just issued a folder describing a new compound for the removal of rust.

Forthcoming Meetings

Eighteenth Annual Automobile Salon, Commodore Hotel, New York City, December 3 to 9, 1922.

American Society of Mechanical Engineers, annual convention, December 4 to 7, 1922, New York City. Secretary, Calvin W. Rice, 29 West 39th St., New York City.

American Institute of Weights and Measures, annual meeting December 8, 1922, United Engineering Societies' Building, 29 West 39th St., New York City. Chas. C. Stutz, 115 Broadway, New York City, is secretary.

National Exposition of Power and Mechanical Engineering. Dec. 7 to 13, 1922, Grand Central Palace, New York City. Secretary, Calvin W. Rice, 29 West 39th St., New York City.

National Automobile Chamber of Commerce, National Automobile Show, Grand Central Palace, New York City, January 6 to 13, 1923.

National Automobile Chamber of Commerce, National Automobile Show, January 27 to February 3, 1923, Coliseum and First Regiment Armory, Chicago, Ill.

American Engineering Council, Annual Meeting, January 11 and 12, at the headquarters of F. A. E. S., 24 Jackson Place, Washington, D. C. L. W. Wallace, Secretary.

American Institute of Electrical Engineers, Mid-Winter Meeting, February 14 to 16. Engineering Societies Bldg., New York. F. L. Hutchinson, Secretary.

American Institute of Mining and Metallurgical Engineers, Annual Meeting, February 19 to 21, Engineering Societies Bldg., New York. F. S. Shartless, Secretary.

American Foundrymen's Association, Annual convention, and exhibition at Public Hall, Cleveland, Ohio, April 30 to May 3, 1923. C. E. Hoyt, 140 South Dearborn St., Chicago, is secretary.

American Electro Chemical Society, Semi-annual meeting, Hotel Commodore, New York City, May 3 to 5, 1923. Colin G. Fink, 327 South La Salle St., Chicago, Ill., is secretary.

American Society for Testing Materials, Annual meeting at Atlantic City, June, 1923. C. L. Warwick, 1315 Spruce St., Philadelphia, is secretary.

New and Enlarged Shops

Machine Tools Wanted

Ill., Chicago — Monighan Machine Co., 2030 Carroll Ave.—slotting machine with 24 in. stroke and 36 in. clearance from center of table to housing.

Ill., Chicago—E. H. Stafford Mfg. Co., 218 South Wabash Ave. (manufacturer of furniture)—factory trucks, edge sanding machines and radial boring machines.

Ind., Newcastle—Goodwin Auto Co., J. Goodwin, Proprietor—machinery, tools and equipment for 2 story garage and service works on Race St.

Mass., Charlestown (Boston P. O.)—General Baking Co., Bunker Hill St.—equipment for proposed $100,000 garage on Ferrin St.

Mass., Roxbury (Boston P. O.) — B. White, 44 Holworthy St.—machinery and tools for garage.

Mo., St. Louis—J. Segal, 1231 Market St.—tools, motor and machinery for machine shop (used).

N. Y., Brooklyn—Metropolitan Mechanical Wks., 129 Boerum Pl.—one bench lathe.

N. Y., Buffalo—L. Feldstein, 2022 Seneca St.—machinery and equipment for garage and service station.

N. Y., Buffalo—Genesee Arcade, Inc., 1446 Genesee St.—mechanical equipment for $40,000 garage and service station.

N. Y., Buffalo—A. Korpalski, 1673 Bway.—two 1,000 gal. gas tanks and pumps, also other equipment for service station.

N. Y., Buffalo — M. & M. Oil Co., 20 Breckenridge St.—1,000 gal. gas tank and pump, also other equipment for service station on Huron and Oak Sts.

N. Y., Hamlin—H. E. Lewis—one power driven cutting machine.

N. Y., Rochester—Cullinan-Malcolm Co., Inc., 4322 Lake Ave.—equipment for gasoline and automobile service station.

Pa., Phila.—C. Crowley, Wildey St. and Montgomery Ave. (machinist)—additional machinery for new factory.

Pa., Phila.—Edward Wilkie Motor Co., 917 North Broad St.—machine shop equipment for sales and service station.

Wis., Kenosha—W. Russell, 603 Milwaukee Ave.—automobile repair machinery for proposed $40,000 garage.

Wis., Milwaukee—M. S. Mann., 1219 Holton St.—equipment, including gasoline tank and pump, for proposed $40,000 garage on 4th St.

Ont., Ford—Ford Motor Co. of Canada—equipment for machine shop additions.

Que., Montreal—Menard Garage, 223 St. Ambroise St., M. Menard, Purch. Agt.—lathe and other equipment for garage and repair shop.

Machinery Wanted

Ala., Alco (Brewton P. O.)—Alco Coal Co., F. Rice, Genl. Mgr.—electrical hoisting and mining machinery.

Ala., Wetumpka—J. F. Godard—planing mill, hardwood and veneer mill machinery.

Calif., San Francisco — San Francisco Chronicle, Chronicle Bldg., M. D. DeYoung, owner—equipment for proposed newspaper plant on 5th and Mission Sts.

Calif., San Francisco—Talbot Investment Co., c/o J. E. Kraft & Sons, Archts., Phelan Bldg.—traveling cranes, monorail system, spiral chutes, etc., for proposed warehouse on 8th and Natoma Sts.

Colo., Alamosa—Alamosa Journal—12 x 18 in. job printing press for power equipment.

Colo., Denver—Blaney-Murphy Co., Stock Yards, L. B. Hill, Purch. Agt.—machinery for proposed packing plant on 48th and Gilpin Sts.

Conn., Stafford Springs — Cyril Johnson Woolen Co.—machinery for addition to woolen mill.

Conn., Union City (Naugatuck P.O.)—J. Broderick, 117 Woodbine St. (woolen goods)—two 20 x 60 in. Garnett machines, one Kitson lapping machine, one baling press, one 36 in. jute picker (used).

D. C., Wash.—Bureau of Yards & Docks, Navy Dept., Spec. 4755—electric elevator cranes for Navy Yard, Puget Sound, Wash.

D. C., Wash.—C. R. Forbes, Dir. United States Veterans' Bureau, Arlington Bldg., will receive bids until Dec. 18 for laundry equipment and refrigerating machinery for U. S. Veterans' Hospital at Livermore, Calif.

Ill., Chicago—Chicago Metallic Mfg. Co., 542 West 35th St.—air compressors, hangers, shafting, pulleys and belting.

Ind., Bourbon—News-Minor—7 column newspaper press.

Ind., Warsaw—J. A. Dalton Co.—foundry equipment to replace that which was destroyed by fire.

Ia., Davenport—Linograph Co., Front and Scott Sts.—8 x 12 in. or 10 x 15 in. job press for power equipment.

Ky., Paducah—Paducah Ice Co.—refrigeration machinery and equipment for proposed addition to ice manufacturing plant.

Mass., Brockton—Lapworth Webbing Co., Sumner St.—machinery for addition to factory.

Mass., Clinton—Lancaster Mills, 1 Green St., (manufacturer of ginghams)—machinery for addition to mill.

Mass., Holyoke—J. Wisly, 18 Hitchcock St.—offset press and miscellaneous accessories for proposed addition to printing plant.

Mass., Roxbury (Boston P. O.)—E. Howard Clock Co., 206 Eustis St.—machinery for addition to plant.

Mich., Grand Rapids—Grand Rapids Wire Frame Co., 1719 Elizabeth Ave.—complete spot welder (used).

Minn., Minneapolis—Bd. Educ., 305 City Hall, F. S. Gram, Purch. Agt.—receiving bids until Dec. 4 for woodworking, refrigerating and sheet metal working machinery for Lincoln and Bryant Junior High Schools.

Mo., Bolivar—Stiles Mfg. Co., H. West, Pres.—steel lathe, drills, hack saws, cutoff saws, etc., for foundry and wood working factory, for the manufacture of gravel and coal loaders, etc.

Mo., Bowling Green—Printer, Box 42—complete equipment for job printing, including linotype, paper cutter, job press, hangers and pulleys (used).

Mo., Kansas City—B. & H. Auto Livery Co., 1026 Wyandotte St.—welding machinery and outfit, also power emery wheel, belting, hangers and pulleys.

Mo., Purdy—Review—job printing press, newspaper press and full equipment.

Mo., St. Louis—Haynes-Langenberg Mfg. Co., 4045-57 Forest Park Blvd. (manufacturer of furnaces)—one 20 hp. spot welder and two 20 hp. arc welders.

N. J., Hammonton—Littlefield Ice & Coal Co., A. Littlefield, Purch. Agt.—refrigerating machines, stills and conveyors for ice and cold storage plant.

N. J., Millville—Taubel, Scott & Kitzmiller Co., Millville and Riverside (manufacturer of textiles)—additional ribbers, loopers and latch needle machines for new mill.

N. Y., Buffalo—J. F. Endres—795 East Delevan Ave.—equipment for bakery at 407 Leroy Ave.

N. Y., Buffalo—K. Ostrowski, 19 Sunnyside Ave.—machinery and equipment for the manufacture of soft drinks.

N. Y., Buffalo—Williams Gold Refining Co., 2978 Main St.—equipment for proposed addition to factory.

N. Y., Jamestown—Clarke Baking Co., 809 North Main St.—bakeshop equipment to replace that which was destroyed by fire.

N. Y., Jamestown—New Ice & Coal Co., 925 Clinton St.—refrigeration machinery for proposed ice manufacturing plant.

N. Y., Philmont—Columbine Garment Co. (manufacturer of wearing apparel)—baling press, folding and measuring machine and cloth cutting machinery.

N. Y., Rochester—J. Lockhart, 979 Harvard St.—machinery and equipment for the manufacture of picture frames, for factory on Elwood Ave.

N. Y., Rochester—M. Michael, 71 North Water St.—bandsaw, swing saw, variety saw, jointer and pony planer.

N. Y., Rochester—Standard Oil Co. of New York, 312 Wilder Bldg.—tools and equipment for gasoline station on North Clinton Ave.

N. Y., South Dayton — Mohawk Condensed Milk Co.—machinery and equipment for the manufacture of evaporated milk.

N. Y., Wellsville—Andover Silk Weaving Corp., South Main St.—60 silk weaving looms and other equipment for silk mill.

N. Y., Westfield—Welch Grape Juice Co., Welch Bldg.—machinery and equipment for grape juice plant at Springdale, Ark.

O., Columbus — Columbus Sheet Metal Wks., Lynn and Ludlow Sts., O. C. Hearing, Proprietor—new sheet metal working equipment, including breaker, slotter, etc.

O., Columbus—Modern Woodworking Co., 476 South High St., C. F. Biederman, Purch. Agt.—one sticker, one double cutoff saw, one double spindle shaper and one tenon machine.

O., Greenville—Allied Belting Co.—looms and other equipment for weaving cotton duck into belting.

O., London—Williams Co. (manufacturer of steel wool)—machinery and equipment for addition to factory.

O., Springfield—Fairbanks Piano Plate Co., Kenton St.—equipment for factory to replace that which was destroyed by fire.

Pa., Bridesburg (Phila. P. O.)—Abrasive Co., Tacony and Fraley Sts. (emery and other products)—additional metal working machinery, cloth and paper coating machines, also machinery to work abrasives, etc.

Pa., Erie—The Northwestern Motors Co., 21st and State Sts.—machinery and equipment for factory to replace that which was recently destroyed by fire.

Pa., Glassmere—Allegheny Plate Glass Co.—machinery and equipment for $100,000 addition to glass factory.

Pa., Johnstown—Edward Hahn Packing Co., Hickory St. and Baltimore & Ohio R.R.—trolley conveying system and ice machines.

Pa., Johnstown—National Radiator Co., Central Ave. and Ohio St., S. Moore, Genl. Mgr.—one electric overhead crane.

Pa., Lebanon—J. Warren Light—machinery and equipment for the manufacture of machine screws and similar products.

Pa., Manyunk (Phila. P. O.)—R. Krook, Main St. (manufacturer of carpet yarns, rugs, etc.)—additional sets, mule spindles, etc.

Pa., Norristown—Ballard Knitting Co.—10 x 12 in. Wildman body machines with revolving cylinders.

Pa., Norristown—Bd. Educ.—vocational equipment for $250,000 junior high school.

Pa., Phila.—Commercial Truck Co., 27th and Brown St.—one No. 3 Nazel air hammer.

Pa., Phila.—M. Dam, 7205 Buist Ave. (electro plating)—rumbling barrels, plating dynamo, wood plating tank, steel tank, polishing machines, etc.

Pa., Phila.—H. J. O'Donnell, 6106 Vine St. (tinners and sheet metal works)—one set of 30 in. and one set of 36 in. rollers, one turning machine, one folder, tinners' tools, etc.

Pa., Phila.—Paper Mfg. Co., 562 Cherry St.—machinery for the manufacture of paper, also belting, pulleys, etc., for new factory.

Pa., Phila.—Pennsylvania R.R. Co., 17th and Filbert Sts., M. Smith, Purch. Agt.—1,500 lb. steam hammer.

Pa., Pittsburgh—Pittsburgh Stencil & Tool Co., 40 Water St.—metal cutting band saw.

Pa., Swarthmore—E. F. Woodhead—machinery and equipment for the manufacture of paper products.

Pa., Wayne—Bd. Educ., F. Seaggs, Secy.—vocational equipment for proposed high school.

R. I., Woonsocket — **Fairmont Worsted Co.**, 18 Worrall St., J. F. Sweeney, Purch.

The Weekly Price Guide

RISE AND FALL OF THE MARKET

Advances—Steel bars quoted at $2.10 per 100 lb., f.o.b. Pittsburgh, for delivery in first quarter of 1923. Aluminum ingots, ton lots, advanced 2½c. per lb. during week; following rise of 2c. per lb. for the week preceding.

Declines—Although shapes, plates and bars are holding to the $2 level, some mills have shown willingness to cut under this price, to the extent of $1@$2 per ton, f.o.b. mill. Plates have been shaded to $1.85@$1.90 for special lots of 1,000 tons or more. Pig-iron market remains weak, with improvement in coke production and the car supply. Tin plate prices remain unchanged. This item represents the only steel product which did not advance in the general market rise, started last spring. Zinc quoted in New York warehouses at 7¼c. as against 7⅞c. per lb., last week. Lead, quiet; down ⅛c. per lb. in East St. Louis. Linseed oil, f.o.b. New York, 90c. as compared with 93c. per gal., one week ago. Lard oils quiet without change in price. No improvement in demand for lubricants.

IRON AND STEEL

PIG IRON — Per gross ton — Quotations compiled by The Matthew Addy Co.:

CINCINNATI	
No. 2 Southern	$28.55
Northern Basic	31.27
Southern Ohio No. 2	31.71
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	33.27
BIRMINGHAM	
No. 2 Foundry	23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	31.14
Virginia No. 2	37.17
Basic	28.26
Grey Forge	29.64
CHICAGO	
No. 2 Foundry local	30.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	31.50
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	28.50
Basic	28.00
Bessemer	31.00

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	6.0
New York	5.5
Chicago	4@5

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	New York	Cleveland	Chicago
No. 10	2.50@2.60	4.19	3.70	4.00
No. 12	2.60@2.70	4.24	3.75	4.05
No. 14	2.70@2.75	4.29	3.80	4.10
No. 16	2.90@3.05	4.39	3.90	4.20
Black				
Nos. 17 and 21.	3.20@3.35	4.70	4.20	4.70
Nos. 22 and 24.	3.25@3.40	4.75	4.25	4.70
Nos. 25 and 26.	3.30@3.45	4.80	4.30	4.75
No. 28	3.35@3.50	4.90	4.40	4.85

Galvanized	Pittsburgh	New York	Cleveland	Chicago
Nos. 10 and 11.	3.35@3.50	4.90	4.40	4.85
Nos. 12 and 14.	3.45@3.60	5.00	4.50	4.95
Nos. 17 and 21.	3.75@3.90	5.30	4.80	....
Nos. 22 and 24.	3.90@4.05	5.45	4.95	5.45
No. 26	4.05@4.20	5.60	5.10	5.55
No. 28	4.35@4.50	5.90	5.40	5.90

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

Steel Inches	Black	Galv.	Iron Inches	Black	Galv.
		BUTT WELD			
1 to 3	66	54½	¾ to 1½	34	19
		LAP WELD			
2	59	47½	2	29	15
2½ to 6	63	51½	2½ to 4	32½	19
7 to 8	60	47½	4½ to 6	32½	19
9 to 12	59	46½	7 to 12	30	17
		BUTT WELD, EXTRA STRONG, PLAIN ENDS			
1 to 1½	64	53½	¾ to 1½	34	20
2 to 3	65	54½			
		LAP WELD, EXTRA STRONG, PLAIN ENDS			
2	57	46½	2	30	17
2½ to 4	61	50½	2½ to 4	33	21
4½ to 6	60	49½	4½ to 6	32	20
7 to 8	56	43½	7 to 8	25	13
9 to 12	50	37½	9 to 12	20	8

Malleable fittings. Classes B and C, Banded, from New York stock sell at net list. Cast iron, standard sizes, 20–5% off.

WROUGHT PIPE—Warehouse discounts as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	57%	44%	55½%	43½%	62½%	48½%
2½ to 6 in. steel lap welded	54%	41%	53½%	40½%	59½%	45½%

Malleable fittings. Classes B and C, Banded, from New York stock sell at list less 6%. Cast iron, standard sizes, 32% off.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.50
Spring steel (light) (base)	6.00	6.00	6.00
Coppered Bessemer rods (base)	6.03	8.00	6.10
Hoop steel	4.39	3.71	3.90
Cold rolled strip steel	6.75	8.25	7.25
Floor plates	5.50	5.16	5.50
Cold finished shafting or screw	3.90	3.75	3.70
Cold finished flats, squares	4.40	4.25	4.20
Structural shapes (base)	3.14	3.01	3.02½
Soft steel bars (base)	3.04	2.91	2.92½
Soft steel bar shapes (base)	3.04	2.91	2.92½
Soft steel bands (base)	3.84	3.61	3.55
Tank plates (base)	3.14	3.01	3.02½
Bar iron (2.60 at mill)	3.04	2.91	2.92½
Drill rod (from list)	55@60%	40%	50%
Electric welding wire:			
5/32	8.00		12@13
⅛	6.50		11@12
5/32 to ¼	6.25		10@11

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York	14.25
Tin, 5-ton lots, New York	36.87½
Lead (up to carlots), St. Louis 6.85@6.90; New York	7.50
Zinc (up to carlots), St. Louis 6.95@7.00; New York	7.50

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	25.20	23.00	23.00
Antimony (Chinese), ton spot	7.25@7.37½	8.50	7.75
Copper sheets, base	21.50	22.00	23.00
Copper wire (carlots)	16.00	18.00	16.25
Copper bars (ton lots)	20.00	23.00	19.50
Copper tubing (100-lb. lots)	24.75	25.00	23.00
Brass sheets (100-lb. lots)	18.50	20.75	18.75
Brass tubing (100-lb. lots)	23.00	24.00	20.50

—Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Brass rods (1,000-lb. lots)	17.00	19.00	15.75
Brass wire (carlots)	19.00	20.75	.....
Zinc sheets (casks)	10.25	10.25	.....
Solder (½ and ½), (caselots)	27.50	24.50	20.00
Babbitt metal (83% tin)	35.00	47.00	36.00
Babbitt metal (35% tin)	25.00	17.50	.....
Nickel (ingot and shot), Bayonne, N. J.	36.00	.....	.....
Nickel (electrolytic), Bayonne, N. J.	39.00	.....	....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb.

Malleable nickel ingots	45
Malleable nickel sheet bars	47
Hot rolled rods, Grades "A" and "C" (base)	50
Cold drawn rods, Grades "A" and "C" (base)	60
Copper nickel ingots	37
Hot rolled copper nickel rods (base)	45
Manganese nickel hot rolled (base) rods "D"—low manganese	54
Manganese nickel hot rolled (base) rods "D"—high manganese	57

Base price of monel metal in cents per lb., f.o.b. Bayonne, N. J.:

Shot	32.00	Hot rolled machined rods (base)	48.00
Blocks	32.00	Hot rolled rods (base)	40.00
Ingots	38.00	Cold drawn rods (base)	50.00
Sheet bars	40.00	Hot rolled sheets (base)	45.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Copper, heavy, and crucible	12.00	12.50	12.00
Copper, heavy, and wire	11.75	11.75	11.50
Copper, light, and bottoms	9.75	10.00	10.50
Lead, heavy	4.75	5.50	5.75
Lead, tea	4.25	4.50	4.75
Brass, heavy	7.00	9.75	9.25
Brass, light	6.00	5.50	6.00
No. 1 yellow brass turnings	6.50	6.75	7.00
Zinc	3 00	4.00	4.50

TIN PLATES—American Charcoal Plates—Bright—Cents per lb.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	20.00	18.25	18.50
IX,	20x28, 112 sheets	23.00	21.00	20.90
"A" Grade:				
IC,	20x28, 112 sheets	17.00	16.00	17.00
IX,	20x28, 112 sheets	20.00	18.75	19.60
Coke Plates, Bright				
Prime, 20x28 in.:				
100-lb.,	112 sheets	12.50	11.00	14.50
IC,	112 sheets	12.80	11.40	14.80
Terne Plate				
Small lots, 8-lb. Coating:				
100-lb.,	14x20	7.00	6.00	7.25
IC,	14x20	7.25	6.25	7.40

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.09@$0.11½	$0.12	$0.11½
Cotton waste, mixed, per b.	.065@.10	.09	.08
Wiping cloths, 13½x13¾, per lb.	.16	32.00 per M	.10
Wiping cloths, 13½x20½, per lb.	.20	48.00 per M	.13
Sal soda, 100 lb. lots	2.80	2.40	2.65
Roll sulphur, per 100 lb.	2.85	3.25	3.50
Linseed oil, per gal., 5 bbl. lots	.90	1.01	.95
White lead, dry or in oil	100 lb. kegs.	New York,	13.25
Red lead, dry	100 lb. kegs.	New York,	13.25
Red lead, in oil	100 lb. kegs.	New York,	14.75
Fire clay, per 100 lb. bag		.80	1.00
Coke, prompt furnace, Connellsville	per net ton	$6.75@7.25	
Coke, prompt foundry, Connellsville	per net ton	7.50@8.50	

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	40%	50-10-5%	50%
1½ and 1¼x3 in. up to 12 in.	20%	50%	50%
With cold punched sq. nuts	25%	$3.50 net	....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	30%	3.50 net	$4.00 off
Button head bolts, with hex. nuts	15%	3.90 net	.....
Hex. head and hex. nut bolts	20%	.....	65-5%
Lag screws, coach screws	40%	.....	60-5%
Square and hex. head cap screws	70%	70%	70-10%
Carriage bolts, up to 1 in. x 30 in.	30%	40–10%	45%
Bolt ends, with hot pressed nuts	40%	.....	55%
Tap bolts, hex. head, list plus	20%	.....	.....
Semi-finished nuts ⅝ and larger	60%	70%	80%
Case-hardened nuts	50%	.....	.....
Washers, cast iron, ½ in., per 100 lb. (net)	$6.00	$3.50	$3.50
Washers, cast iron, ⅜ in. per 100 lb. (net)	4.50	4.00	3.50
Washers, round plate, per 100 lb. Off list	3.00	5.00	3.50 net
Nuts, hot pressed, sq., per 100 lb. Off list	1.00	3.00	4.00
Nuts, hot pressed, hex., per 100 lb. Off list	1.00	3.00	4.00
Nuts, cold punched, sq., per 100 lb. Off list	1.00	3.00	4.00
Nuts, cold punched, hex., per 100 lb. Off list	1.00	3.00	4.00
Rivets:			
Rivets, 7/16 in. dia. and smaller	45%	60%	60%
Rivets, tinned	50%	60%	4½c. net
Button heads ⅜-in., ½-in., 1x2 in. to 5 in., per 100 lb. (net)	$5.00	$3.90	$3.75
Cone heads, ditto (net)	5.10	4.00	3.85
1½ to 1¾-in. long, all diameters, *EXTRA* per 100 lb	0.25	.....	0.15
⅝ in. diameter *EXTRA*	0.15	.....	0.15
½ in. diameter *EXTRA*	0.50	.....	0.50
1 in. long, and shorter *EXTRA*	0.50	.....	0.50
Longer than 5 in *EXTRA*	0.25	.....	0.25
Less than 200 lb *EXTRA*	0.50	.....	0.50
Countersunk heads *EXTRA*	0.35	.....	$3.70 base
Copper rivets	55–5%	50%	50%
Copper burs	35%	50%	20%

Lard cutting oil (50 gal. bbl.) per gal.	$0.60	$0.50	$0.67½
Machine lubricant, medium-bodied (50 gal. bbl.), per gal.	0.33	0.35	0.40
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, New York, per ply, 12-in. wide, per lin.ft., $2.88:			
Medium grade	30–10%	40½%	50%
Heavy grade	20–5–2½%	30–5%	40–5%
Rubber and duck:			
First grade	60–5%	50–10%	40-10%
Second grade	65–10%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in.,			
No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.84	$5.84	$6.48
Emery paper	8.80	11.00	8.80
Emery cloth	27.84	31.12	29.48
Flint cloth, regular weight, width 3½ in., No. 1 grade, per 50 yd. roll.	4.50	4.28	4.95
Emery discs, 6 in. dia., No. 1 grade, per 100:			
Paper	1.32	1.24	1.40
Cloth	3.02	2.67	3.20

Agt.—one narrow pattern loom, one jack spool winder and one single spooling machine (used).

Tenn., Memphis — Stryker Kot-N-Wood Co., 1040 Oakland Ave.—machinery and equipment for $65,000 plant, for the manufacture of building specialties.

Tex., Ennis—News—7 column fast newspaper press.

W. Va., Wheeling—Wheeling Box Co., 3007 Chaplin St.—automatic cut saw, rip saw and belting.

Wis., Beloit—T. B. Goodall, 433 Broad St.—oil storage tanks and pumps for proposed filling station.

Wis., Clinton—Robert Work & Co., Inc., F. W. Herron, Vice Pres.—machinery and equipment for the manufacture of septic and storage tanks, chemical toilets and sanitation systems.

Wis., Fond du Lac—Gurney Refrigerator Co., 64 South Brook St., E. G. Vail, Pres.—machinery for the manufacture of refrigerators, also machinery for power plant.

Wis., Jackson—Jackson Canning Co., M. Gardiner, Mgr.—electric power machinery for proposed canning factory.

Wis., Janesville—Janesville Caloric Co., F. M. Coyle, Genl. Supt.—machinery, tools and equipment for the manufacture of electric fireless cookers.

Wis., Milwaukee — Milwaukee - Western Fuel Co., 120 Wisconsin St.—chain hoist for proposed repair shop on Clinton St.

Wis., Milwaukee—J. M. Nash, 842 30th St.—woodworking machinery.

Wis., Milwaukee—Wisconsin Ice & Coal Co., 216 West Water St.—ice making machinery for proposed plant on 31st and Galena Sts.

Wis., New London—Wisconsin Cabinet & Panel Co., J. H. McLaughlin, Mgr.—power machinery for proposed box factory.

Wis., Port Washington—Hansen Canning Machine Co.—machinery for the manufacture of special vegetable canning machines for proposed factory at Cedarburg.

Wis., Prairie du Chien—Prairie du Chien Tool Co.—machinery and equipment for the manufacture of wrenches, tools and automotive specialties.

Wis., Sheboygan — Vollrath Co., West Michigan Ave., D. F. Riess, Secy.—special machinery for proposed enameling factory, including annealing and stamping room.

Wis., Waupun — Althouse-Wheeler Co., H. O. Thompson, Mgr.—machinery for the manufacture of wind mills, steel towers, tanks, etc.

Wis., Wisconsin Rapids—Prentiss-Wabers Co.—enameling and special machinery for the manufacture of heating devices.

Ont., Oshawa—Phillips Mfg. Co. (manufacturer of picture moldings, frames, etc.) —machinery and equipment for addition to plant.

Ont., Welland—Welland Packing Co., Ltd.—several thousand dollars worth of machinery for proposed plant at Niagara Falls.

Metal Working Shops

Calif., San Francisco—The Amalgamated Laundries, 8th and Harrison Sts., awarded the contract for the construction of a 1 story garage. Estimated cost $40,000.

Calif., San Francisco — A. S. Bugbee, Archt., 26 Montgomery St., is receiving bids for the construction of a 2 story garage on Sacramento St. near Polk St., for L. R. Lurie, Mills Bldg. Estimated cost $54,000. Noted Nov. 16.

Calif., San Francisco—The Simmons Co., 198 Bay St., manufacturer of metal furniture, beds, etc., awarded the contract for the construction of a 3 story factory and warehouse on Powell and Bay Sts. Estimated cost $250,000.

Calif., San Francisco—The Star Garage Co., 150 Turk St., is having plans prepared for the construction of a 2 story addition to its garage. Estimated cost $60,000. J. L. Stewart, Claus Spreckels Bldg., Archt.

Calif., Watsonville — Watsonville Union High School Dist. awarded the contract for the construction of a machine shop. Estimated cost $5,693. Noted Nov. 9.

Conn., Bridgeport—The Locomobile Co. of America, Inc., 2 Main St., manufacturer of automobiles and trucks, awarded the contract for alterations, and for the construction of a 1 story, 60 x 180 ft. and 40 x 200 ft. additions to its machine shop.

Conn., Hartford—Kaplan & Goldberg, 32 John St., will build a 1 story, 90 x 100 ft. garage and service station. Estimated cost $40,000.

Conn., Torrington—The Union Hardware Co., Mignon Ave., plans to build a 3 story addition to its plant. Estimated cost $50,000. Architect not announced.

Ill., Chicago—The Advance Fdry. & Pattern Co., 2734 West 36th St., awarded the contract for the construction of a 1 and 2 story, 55 x 142 ft. addition to its factory. Estimated cost $50,000. Noted Oct. 19.

Ill., Chicago — Voightmann & Co., 445 West Erie St., manufacturer of metal windows, awarded the contract for the construction of a 1 story, 280 x 300 ft. factory at 4158 Schubert Ave. Estimated cost $150,000.

Ind., Warsaw—The J. A. Dalton Co. plans to rebuild portion of its foundry which was destroyed by fire. Estimated cost $15,000. Architect not announced.

Ky., Louisville—The Mengel Body Co. is having plans prepared for the construction of an automobile body plant on a 30 acre site on 4th and G Sts. Joseph & Joseph, Francis Bldg., Archts.

Mass., Boston—The Boston Flower Exchange, Inc., 1 Winthrop Sq., awarded the contract for the construction of a 2 story, 135 x 200 ft. garage and mercantile building at 541 Tremont St. Estimated cost $80,000.

Mass., Charlestown (Boston P. O.)—The General Baking Co., Bunker Hill St., awarded the contract for the construction of a 2 story garage on Ferrin St. Estimated cost $100,000.

Mass., West Lynn (Lynn P. O.)—The General Electric Co. will build a 4 story 122 x 157 ft. addition to its factory. Estimated cost $200,000. Noted Sept. 14.

Mich., Holland—The Federal Mfg. Co. is building a plant for the manufacture of warm air furnace accessories (pressed steel). Cost between $60,000 and $100,000.

Mo., Bolivar—The Stiles Mfg. Co. is having plans prepared for the construction of a 46 x 106 ft. foundry and wood working factory, for the manufacture of gravel and coal loaders, etc. Estimated cost $5,000. H. West, Pres. E. Stiles, Aldrich, Engr.

Mo., Webster Groves—The Texas Oil Co., Houston, Tex., awarded the contract for the construction of a 1 story, 40 x 170 ft. garage on Forsythe Ave., here. Estimated cost $40,000.

General Manufacturing

Ind., Hartford City—The Fort Wayne Corrugated Paper Co., Murray and Barr Sts., Fort Wayne, is having plans prepared for the construction of a 1 to 2 story plant for the manufacture of paper, here. Estimated cost $70,000. Mills, Rhines, Bellman & Nordhoff, Ohio Bldg., Toledo, Ohio, Archts.

Ia., Davenport—The Linwood Stone & Cement Co., 713 Kohl Bldg., plans to build a cement plant, capacity 2,000 bbl. per day. Estimated cost $1,500,000. Architect not selected.

Mass., Fitchburg—The Star Worsted Co., manufacturer of Bradford spun worsted yarns, will soon receive bids for the construction of a 5 story addition to its mill, to contain about 40,000 sq.ft. of floor space, to be used for combing, drawing and spinning. Lockwood, Greene & Co., 24 Federal St., Boston, Engrs.

Mass., New Bedford — The Hathaway Mfg. Co., Front St., manufacturer of cotton goods, awarded the contract for the construction of a 1 story, 40 x 98 ft. addition to its mill and a 3 story, 25 x 40 ft. manufacturing building. Estimated cost $40,000.

Mich., Flat Rock—The Ford Motor Co., Highland Park, awarded the contract for the construction of a 1 and 2 story plate glass factory, here. Noted Nov. 2.

Mich., Muskegon—The Central Paper Co. awarded the contract for the construction of additions to its factory, consisting of a 3 story, 90 x 110 ft. warehouse, a 3 story, 55 x 300 ft. machine room and 3 story, 42 x 53 ft., 2 story, 45 x 150 ft. and 4 story, 46 x 90 ft. buildings. Estimated cost $200,000. Noted Nov. 9.

Neb., Fremont—The Fremont Mfg. Co. awarded the contract for the construction of 1 story, 60 x 84 ft., 112 x 140 ft., 56 x 140 ft., 40 x 188 ft. factory buildings for the manufacture of refrigerators, incubators, etc. Estimated cost $50,000.

N. Y., Binghamton — The Binghamton Gas Co., 40 Chenango St., plans to build a fuel oil and gas station, capacity 500,000 gal., on Court St. Estimated cost $10,000. C. Bennett, Genl. Mgr.

N. Y., Buffalo—The Island Warehouse Co., Ganson St. and Ship Canal, awarded the contract for the construction of a 10 story, 9 x 100 x 268 ft. flour mill. Estimated cost $500,000.

N. Y., New York—The Empire State Ice Co., 76 West Monroe St., Chicago, awarded the contract for the construction of a 3 story, 110 x 136 ft. ice making plant on 161st St. and Grant Ave., here. Estimated cost $135,000.

N. Y., Oswego—The Oswego Netherland Co. is having plans prepared for the construction of a 1 story, 100 x 365 ft. ice cream plant. Estimated cost $180,000. The McCormick Co., Inc., Century Bldg., Pittsburgh, Pa., Archts.

O., Ashland—The J. E. Matthews Produce Co. is having plans prepared for the construction of a 3 story, 60 x 75 ft. cold storage building with 15-ton ice making equipment. L. J. Goodrich, 207 East 4th St., Engr.

O., Columbus—The Doddington Co., 451 West Broad St., will build a 2 story, 60 x 100 ft. factory for mill work on Duerr Rd. Estimated cost $25,000.

Pa., Bethlehem—The Kurtz Furniture Co., plans to reconstruct its buildings 3, 4 and 5, which were recently destroyed by fire. Estimated cost $800,000. Architect not announced.

Pa., Clearfield—The Gingery Hardware Co. awarded the contract for the construction of a 3 story, 50 x 100 ft. store, warehouse and planing mill on 4th and Pine Sts. Estimated cost $40,000. D. Gingery, Pres.

Pa., Jeannette — The Amer. Window Glass Co., Farmers Bank Bldg., Pittsburgh, will soon award the contract for the construction of a 1 story, 40 x 828 ft. glass factory and cutting room, here. Estimated cost $175,000. L. J. Pierce, c/o owner, Engr. Private plans.

R. I., Woonsocket — The Rhode Island Knitting Co., Jeffers St., plans to build a 2 story addition to its knitting mill. Estimated cost $50,000. Private plans.

Va., Richmond — The Wortendyke Mfg. Co., foot of 13th St., manufacturer of paper products, has had sketches made for the construction of a 3 story factory. Estimated cost incl. machinery, $200,000. Carneal & Johnston, Chamber of Commerce Bldg., Archts.

W. Va., Fairmont—The Monongah Glass Co. awarded the contract for the construction of a 2 story, 36 x 103 ft. cooper shop and glass factory. Estimated cost $15,000.

W. Va., Huntington—The Carbocite Co., c/o S. J. Hyman, Day and Night Bank Bldg., plans to build a 1 story coal tar refining factory. Estimated cost $100,000. Architect not selected.

Wis., Antigo — The Langlade Creamery Co. will build a 2 story, 50 x 95 ft. bottling plant. Estimated cost $45,000.

Wis., Jackson—The Jackson Canning Co. awarded the contract for the construction of a 1 story, 24 x 30 ft. addition to its canning factory. Estimated cost $8,000.

Wis., La Crosse—The Weisse Mfg. Co., Caledonia and Gillett Sts., plans to build a 2 story, 50 x 100 ft. factory for the manufacture of millwork products. Estimated cost $50,000. J. Weisse, Pres. Architect not selected.

Wis., Madison — The J. Heilprin Fruit Co., West Mifflin St., plans to build a 2 story, 75 x 150 ft. cold storage warehouse on Bedford St. Estimated cost $90,000. J. Heilprin, Pres. Architect not selected.

Wis., Mayville — The Bd. Educ., A. Droeger, Secy., is having plans prepared for the construction of a 2 story, 112 x 274 ft. high school, including manual training plant. Estimated cost $250,000. Parkinson & Dockendorff, Linker Bldg., La Crosse, Archts.

Wis., Milwaukee—The Cedarburg Dairy Co., c/o H. Berns, 1586 Prospect Ave., is having plans prepared for the construction of a 1 story, 100 x 150 ft. dairy on 11th St. Estimated cost $75,000. H. J. Esser, 82 Wisconsin St., Archt.

Wis., Milwaukee—H. J. Esser, Engr. and Archt., 82 Wisconsin St., is receiving bids for the construction of a 4 story, 60 x 210 ft. and a 2 story, 60 x 210 ft. factory buildings for the Harsh-Chapline Shoe Co., 692 Hanover St.

Wis., South Milwaukee—The Pfister & Vogel Leather Co., 443 Virginia St., Milwaukee, awarded the contract for the construction of a 1 story, 63 x 66 ft. addition to its tannery, here. Estimated cost $25,000.

Ont., Chatham—Silverwoods, Ltd., London, is having plans prepared for the construction of a cold storage, ice cream and artificial ice plant. A. E. Silverwood, Mgr.